UCLA
Engineering School

TEAM CENTRAL

Eric Kneer
(Owner)

A E C

Anja Jutraz
(Architect, Slovenia)

Ena Tobin
(MEP , Ireland)

Pinar Okumus
(Structural, USA - Madison)

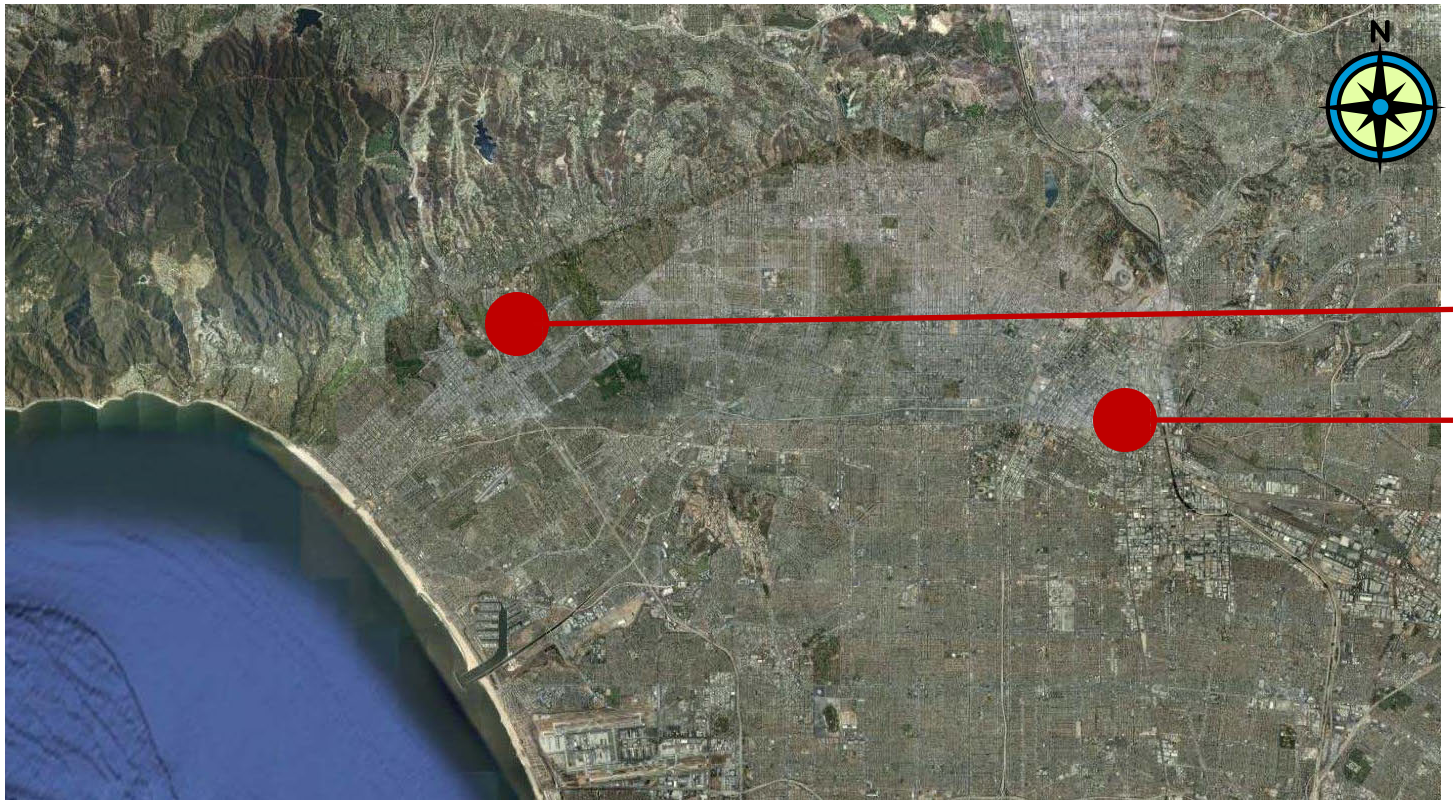
Jonathan Glassman
(Structural, USA - Stanford)

Tobias Wolff
(LFCM, Germany)

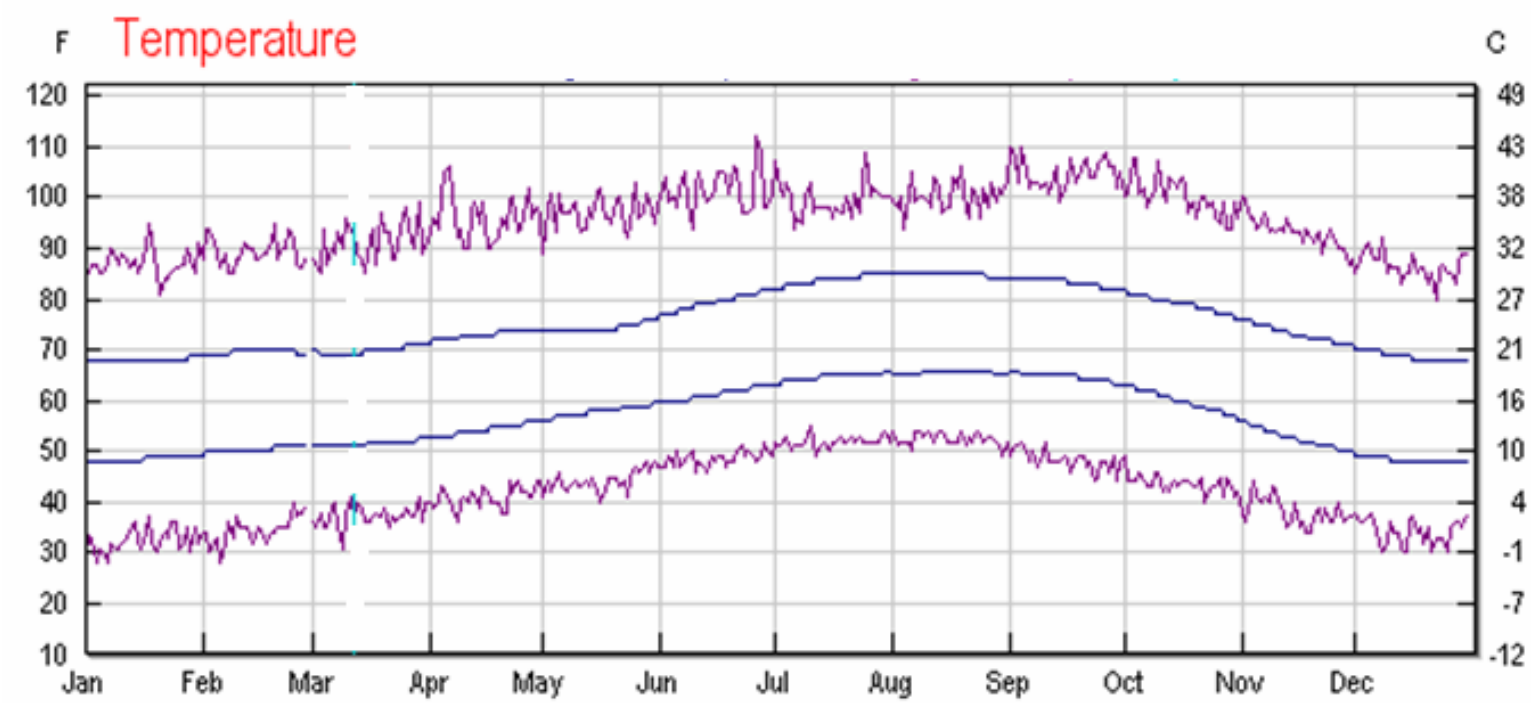
Andres Beijer Lundberg
(CM, Sweden)

Prashant Sharma
(CM, USA, Stanford)

LOCATION



LOCAL WEATHER



Summer Temperature

Avg. Max : 85 F

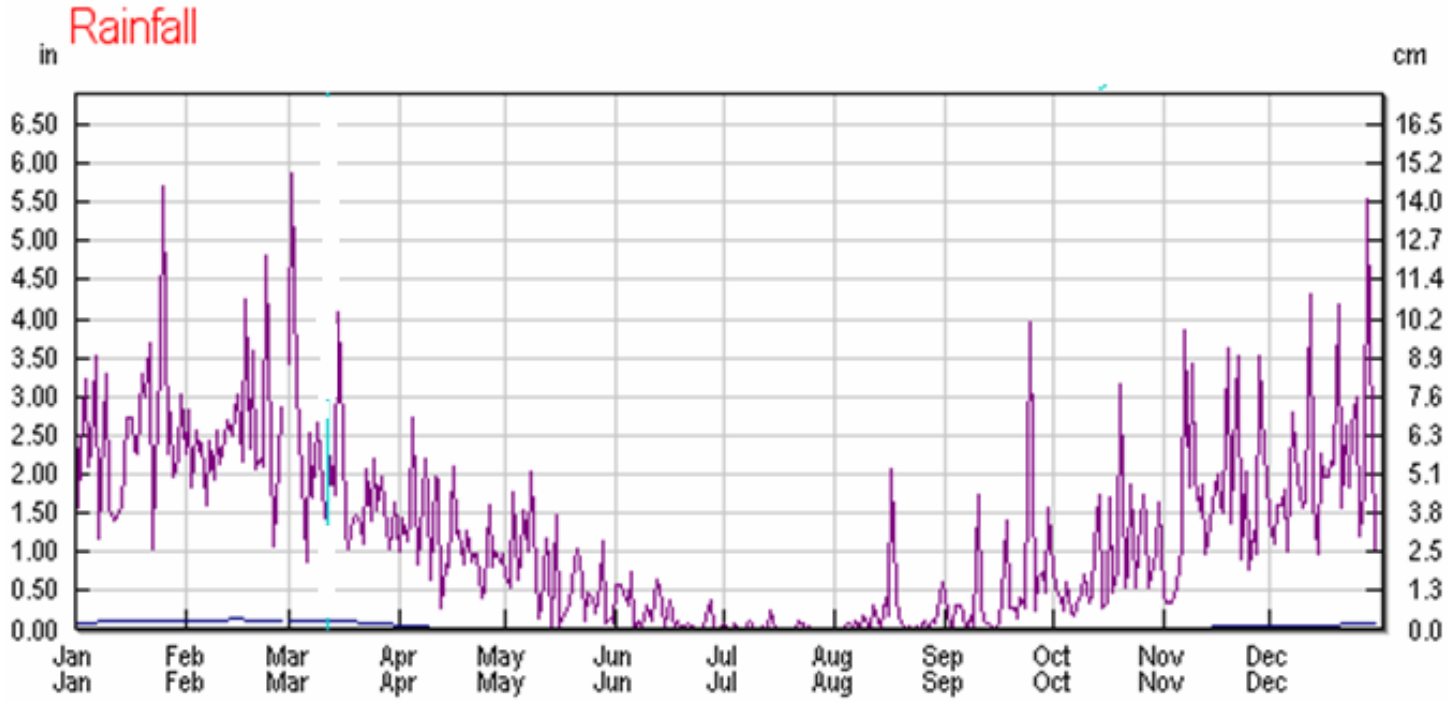
Avg. Min : 61 F

Winter Temperature

Avg. Max: 68 F

Avg. Min : 48 F

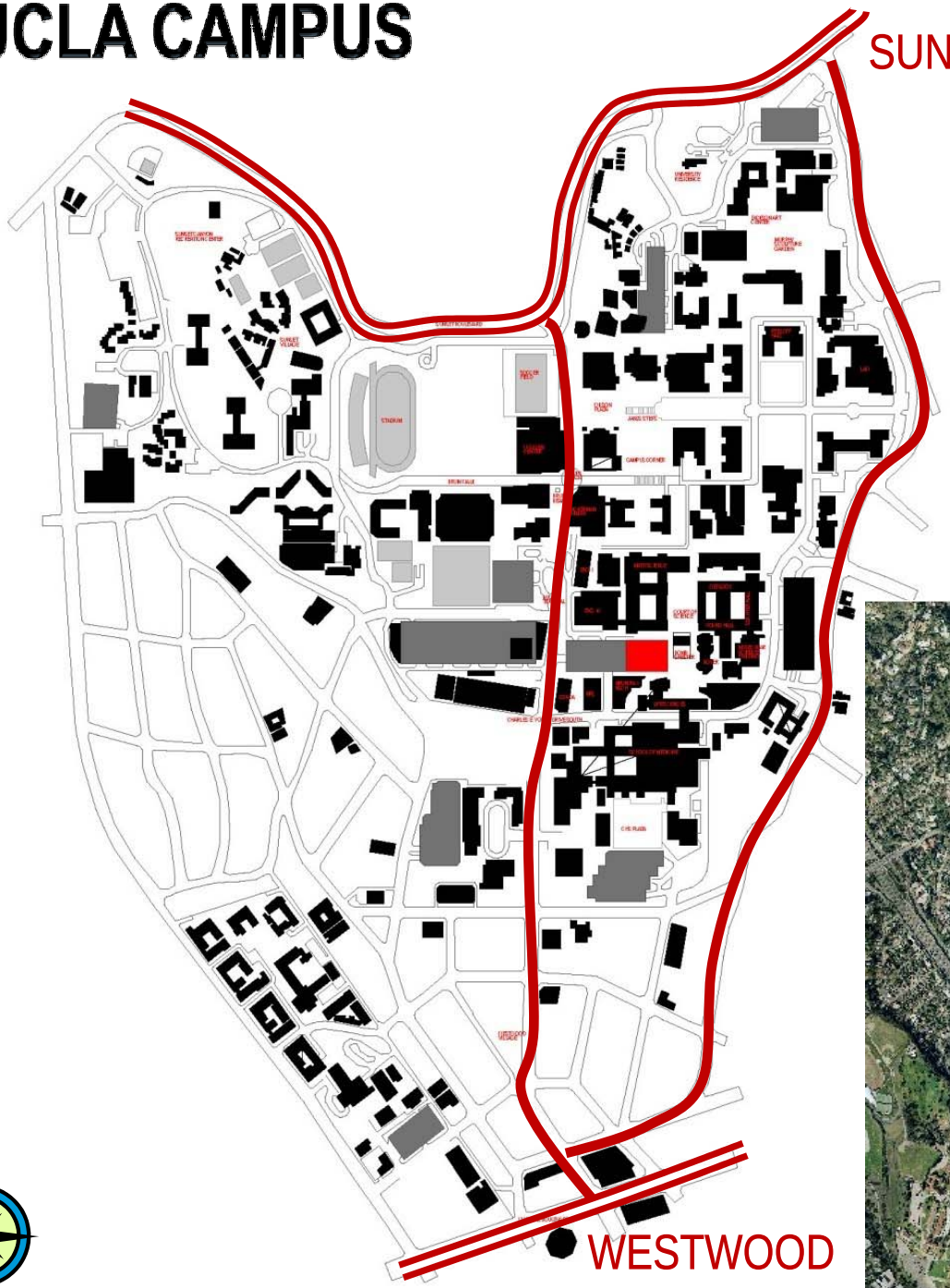
LOCAL WEATHER



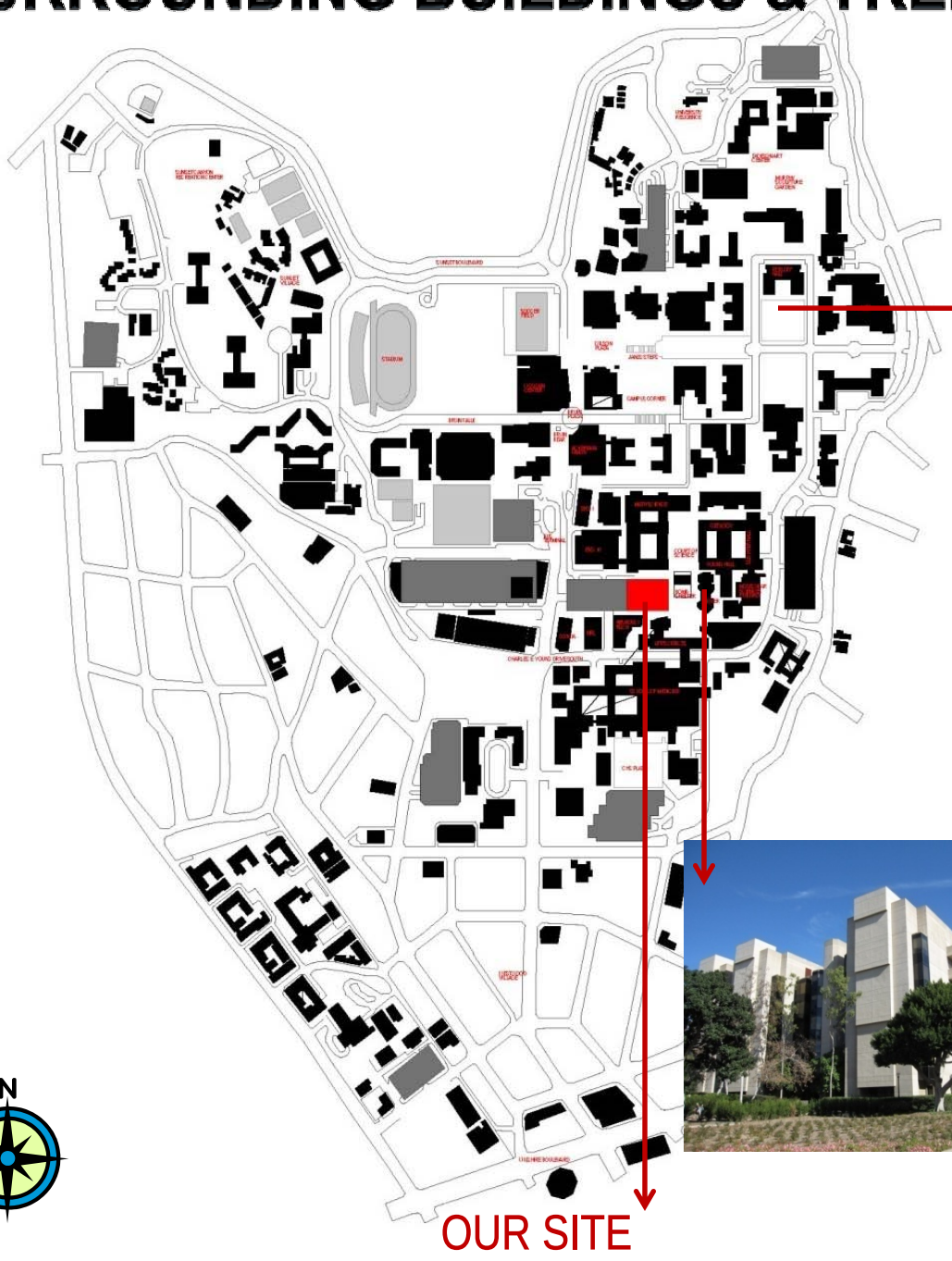
- Rainfall
  Summer:1.75 inch,
  Winter:13.04 inch
- Wind Speed
  Avg. Max. : 8.5 MpH
  Avg. Min. : 6.2 MpH

- Max Humidity
  Summer: 86% (morning)
  Winter: 68% (morning)
- Avg. morning humidity: 79%
- Avg. afternoon humidity: 65%

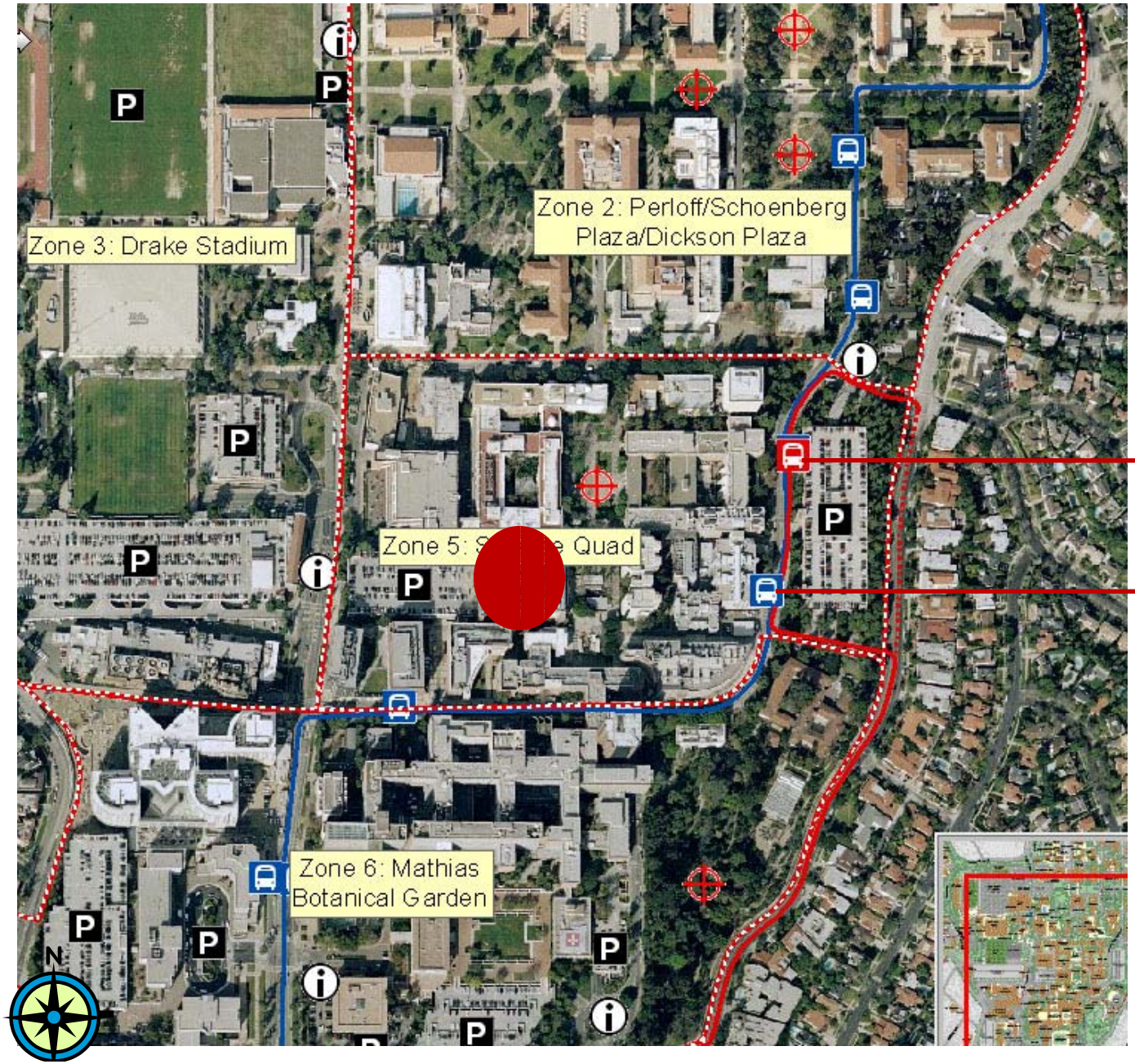
UCLA CAMPUS



SURROUNDING BUILDINGS & TREES



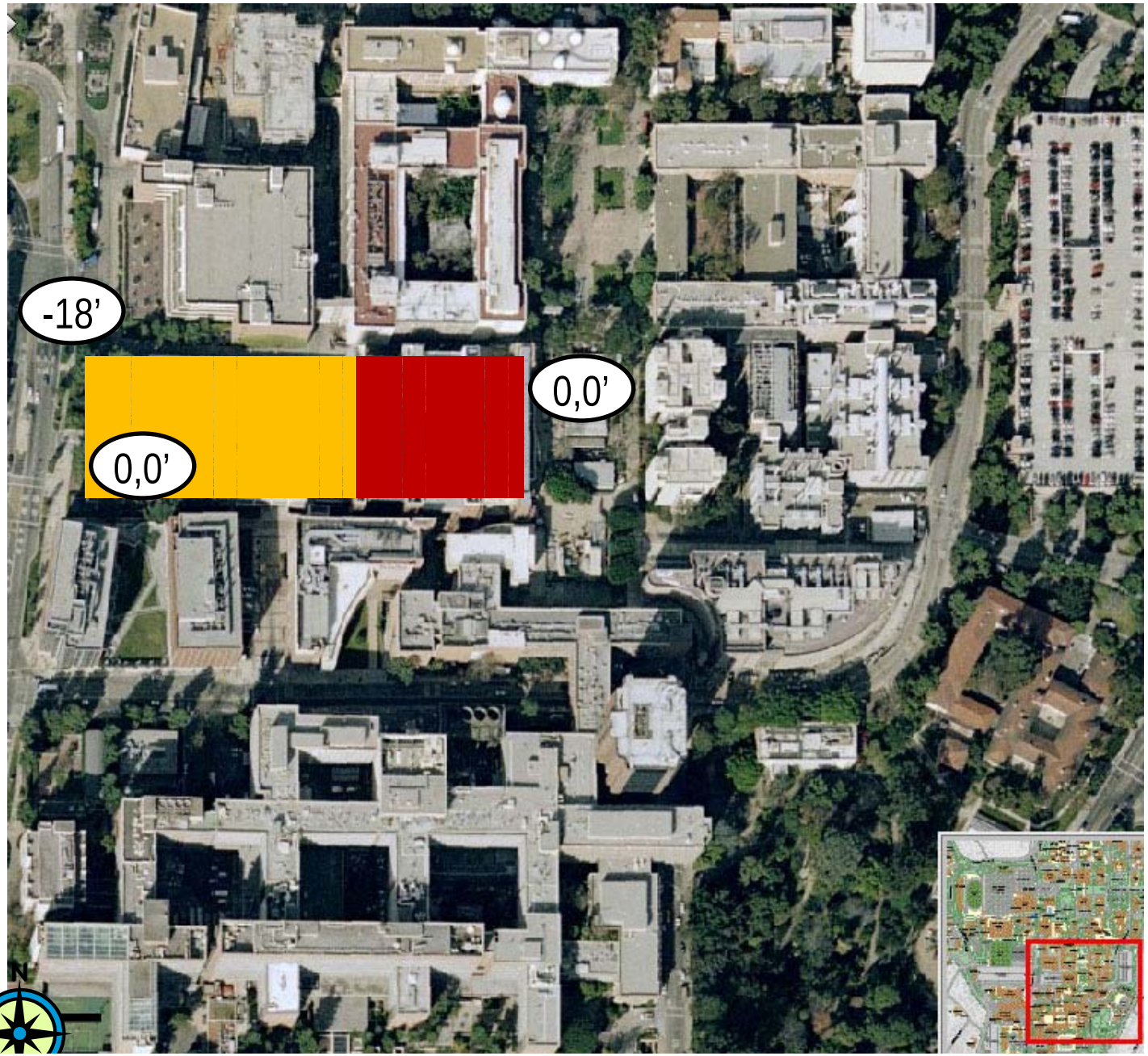
SCIENCE QUAD



BUS STOP

BUS STOP

PARKING GARAGE



OUR SITE

PARKING GARAGE

PHOTOS - courtyard

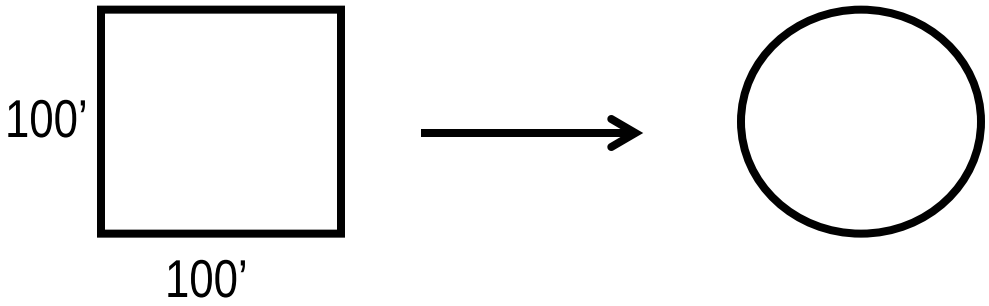
PHOTOS

TWO CONCEPTS

1. CONCEPT

Square – CIRCLE

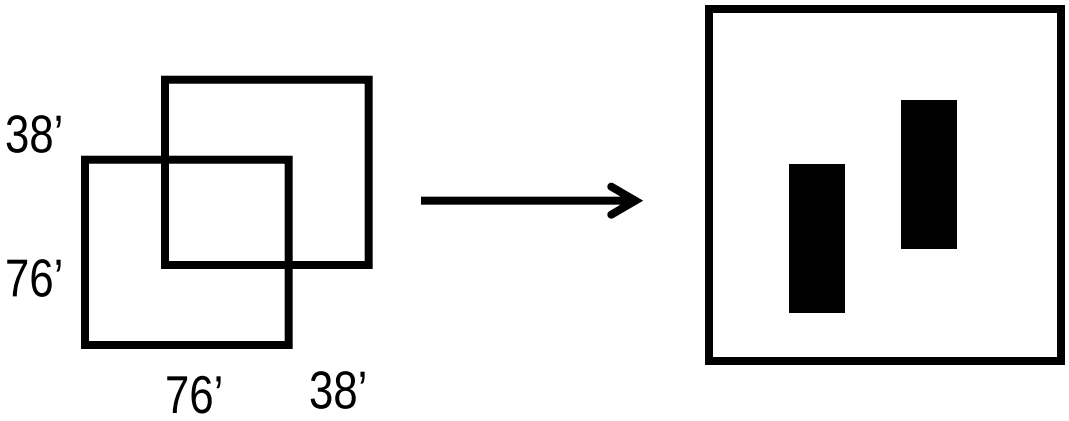
WAVE



2. CONCEPT

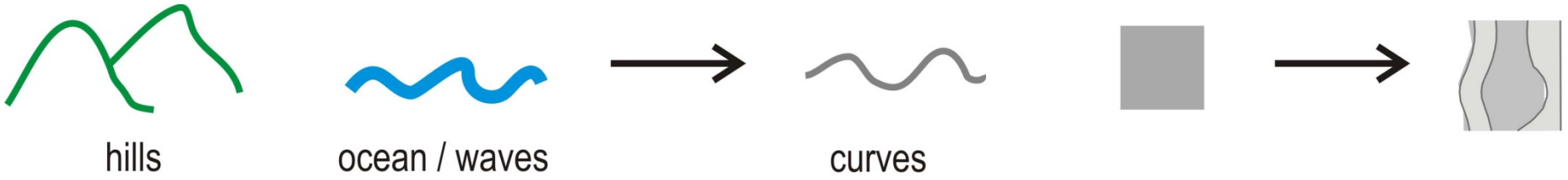
Double diamond – SQUARE

NATURE
- HANDS

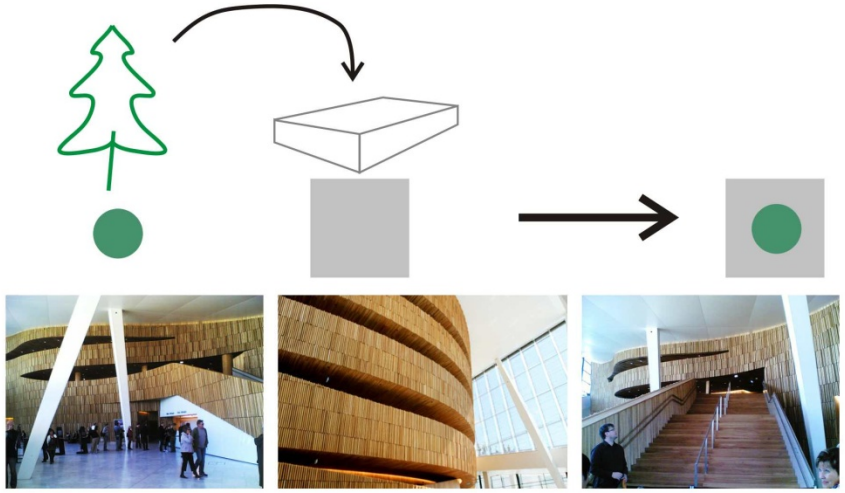


1 CONCEPT – big idea 1

WAVE



- AUDITORIUM - wood



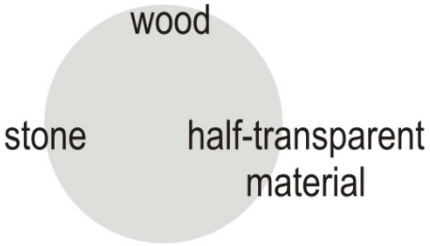
Opera Oslo

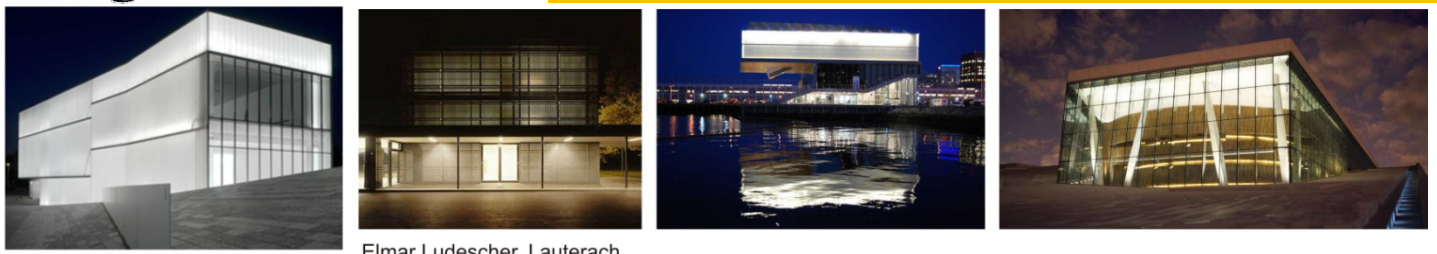
- ROOF

Arata Isozaki, Yamaguchi center for arts and media

AMALGMATION OF 3 TYPES OF CONSTRUCTION MATERIALS

– big idea 1

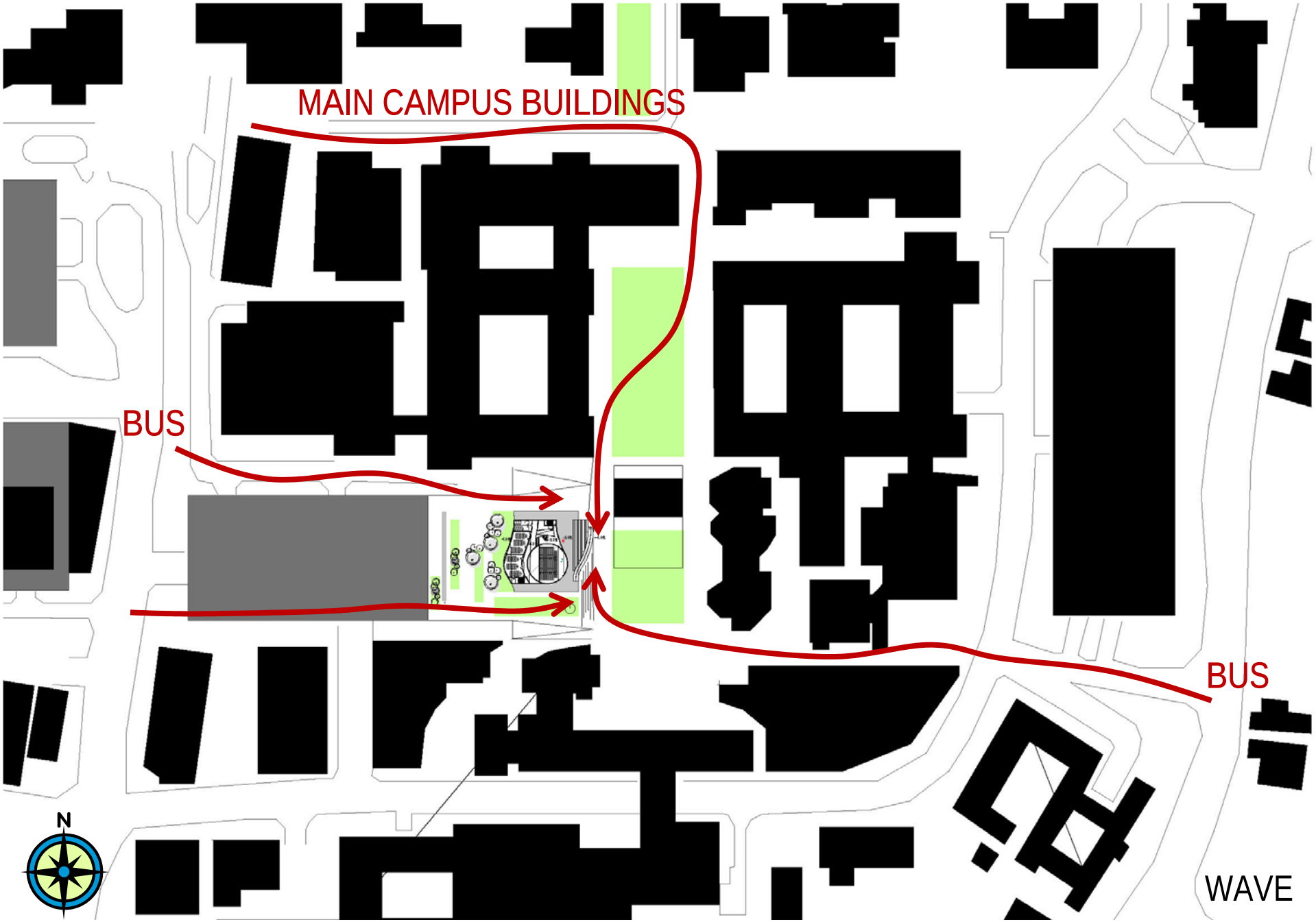




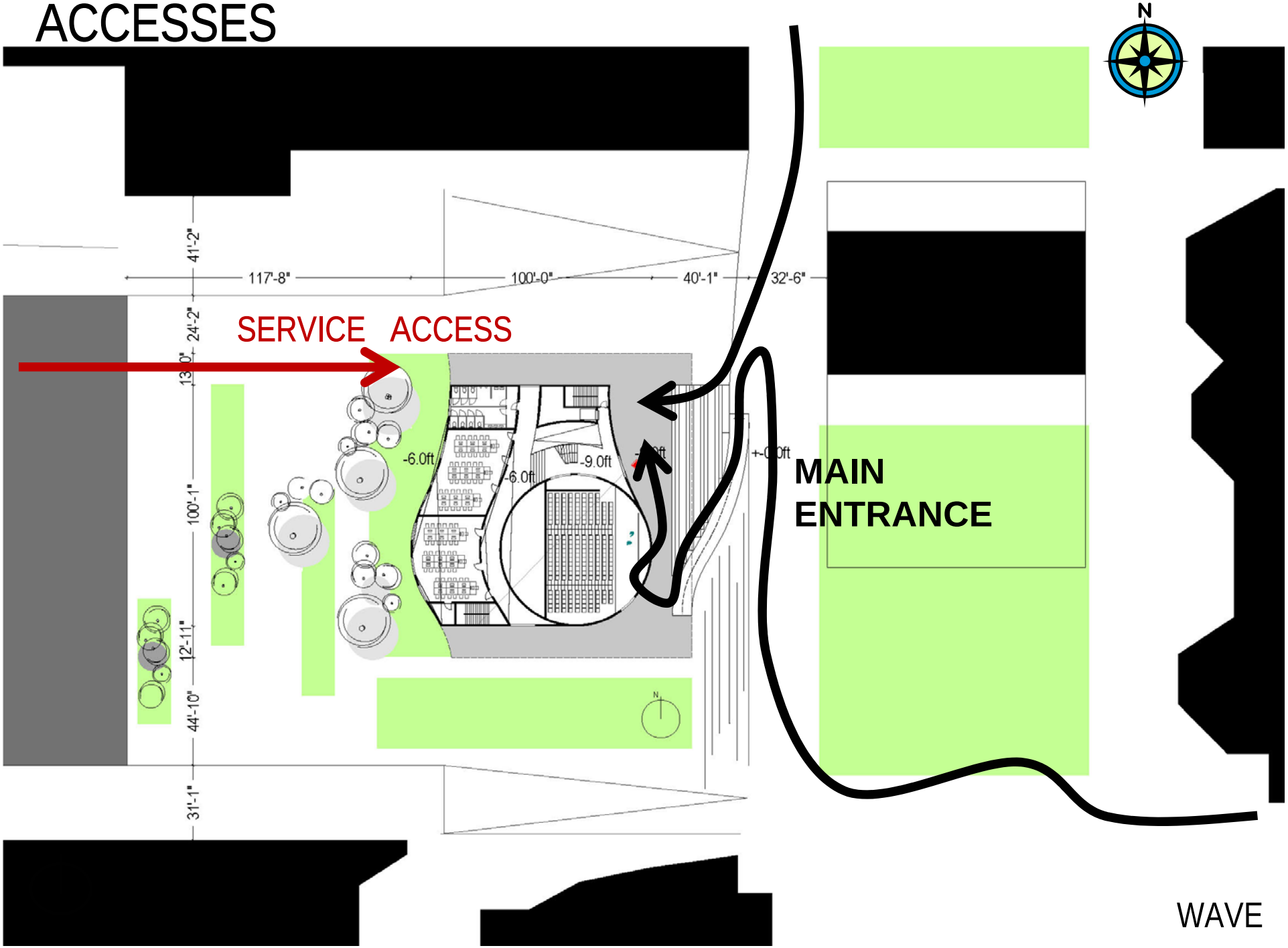
The Nelson-Atkins Museum Of Art, Kansas City, Missouri, United States

Elmar Ludescher, Lauterach, Schule

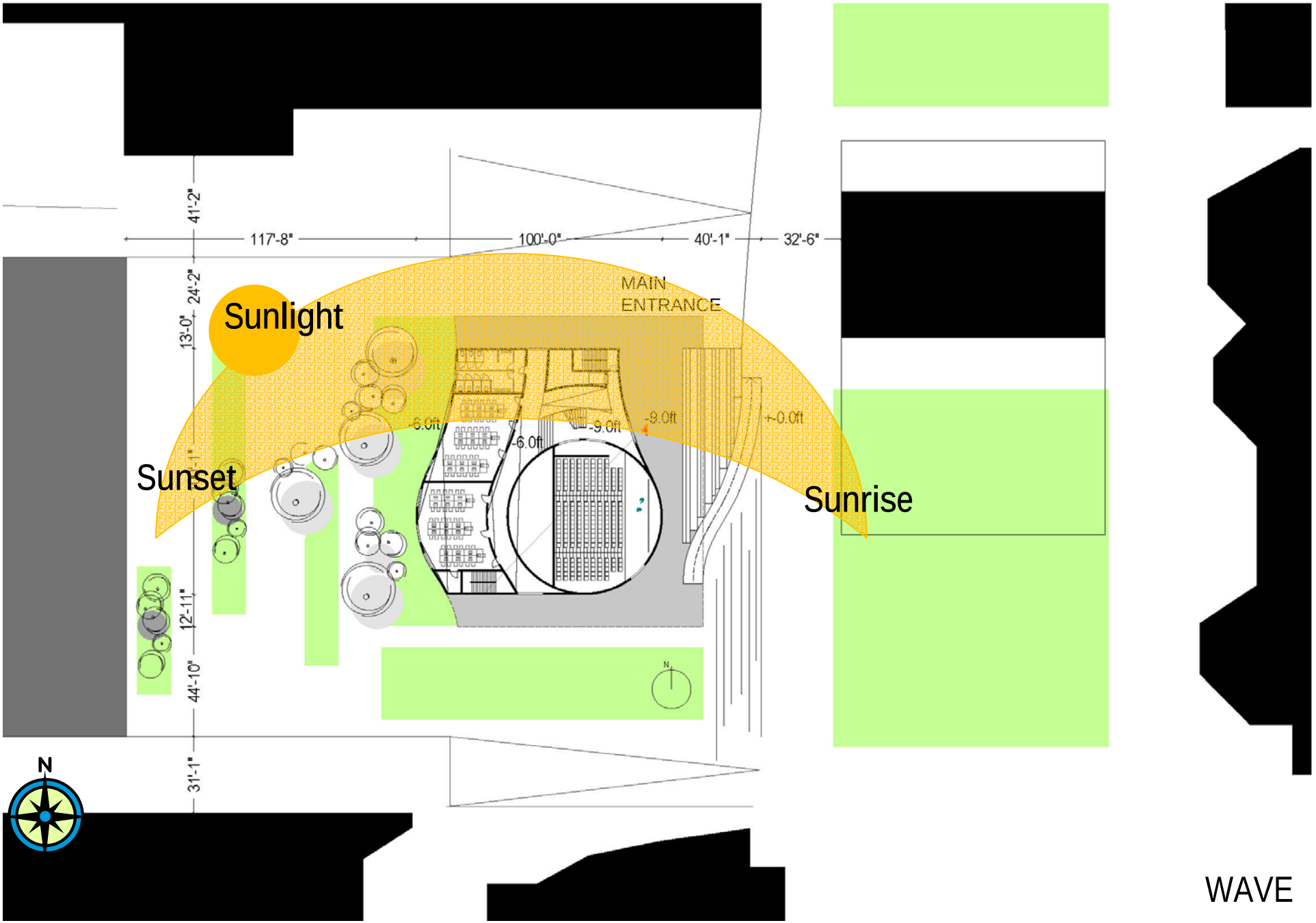
ACCESSES FOR STUDENTS



ACCESSES

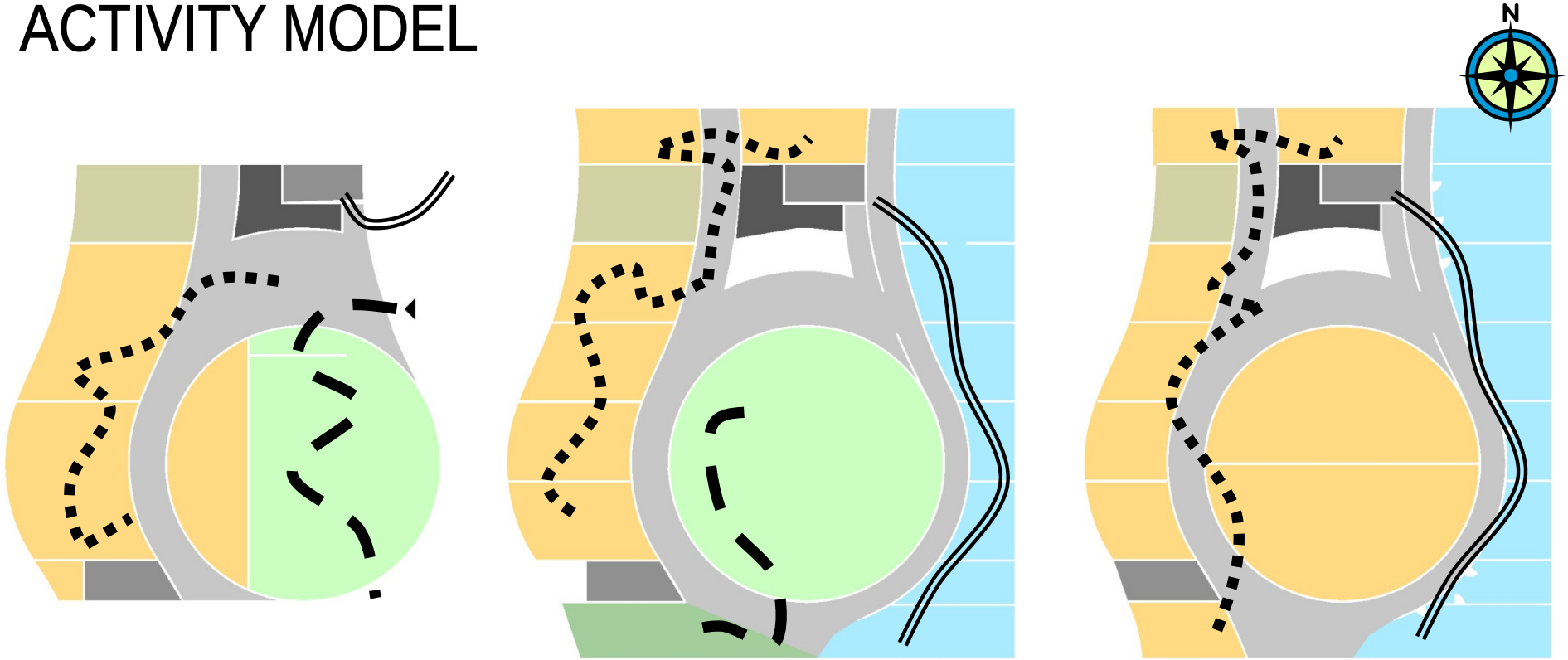

N
41'-2"
117'-8"
100'-0"
40'-1"
32'-6"
SERVICE ACCESS
24'-2"
13'-0"
100'-1"
12'-11"
44'-10"
31'-1"
-6.0ft
-6.0ft
-9.0ft
MAIN
ENTRANCE
WAVE

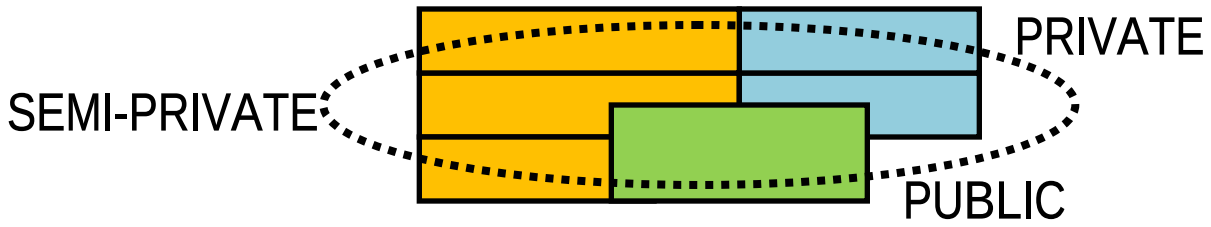
ORIENTATION - SUN



WAVE

ACTIVITY MODEL





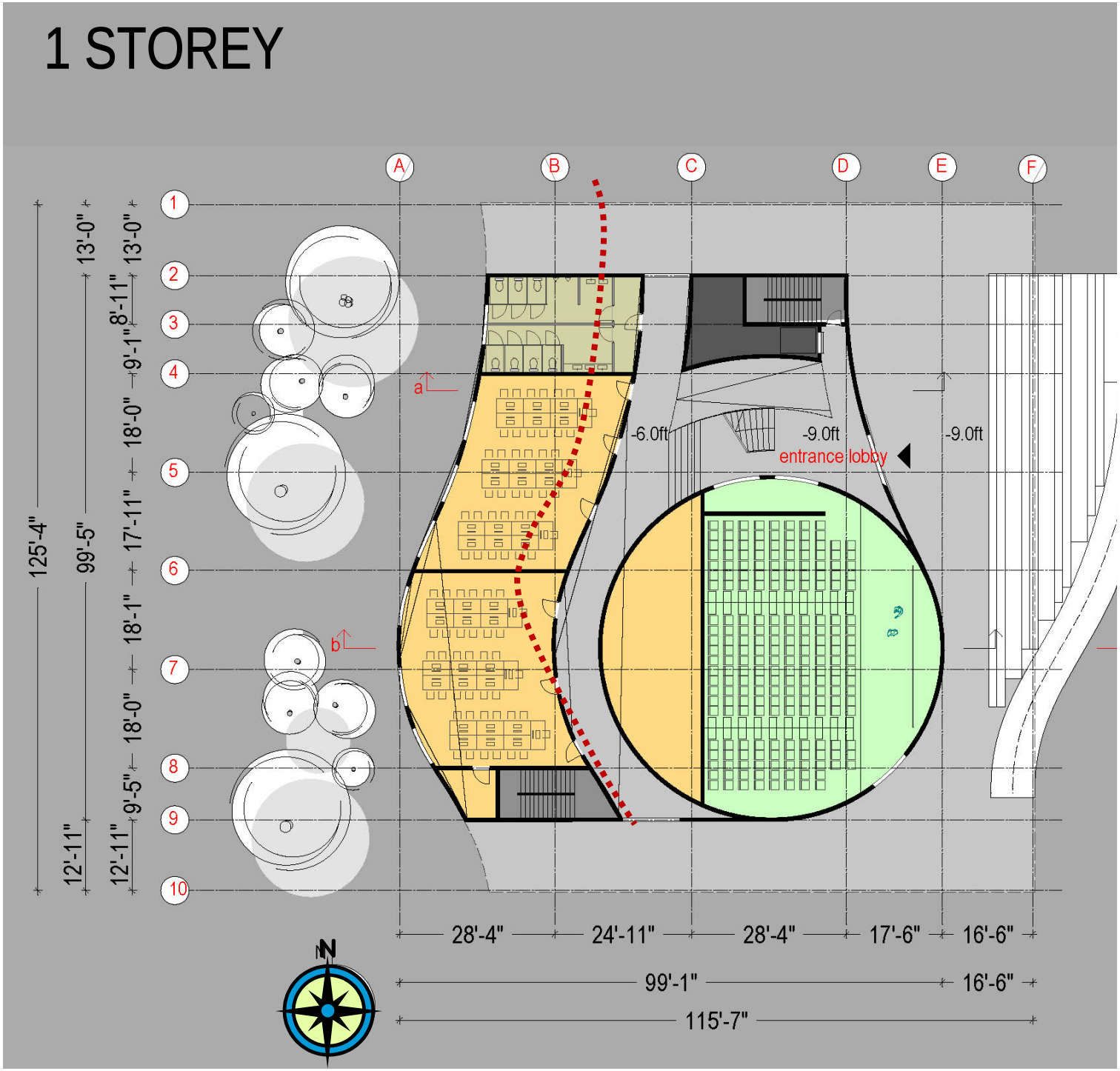
STUDENTS

VISITORS

FACULTY

WAVE

1 STOREY



SERVICES
- CORRIDORS
- MECHANICAL SCHAFT
- STAIRS
- RESTROOMS

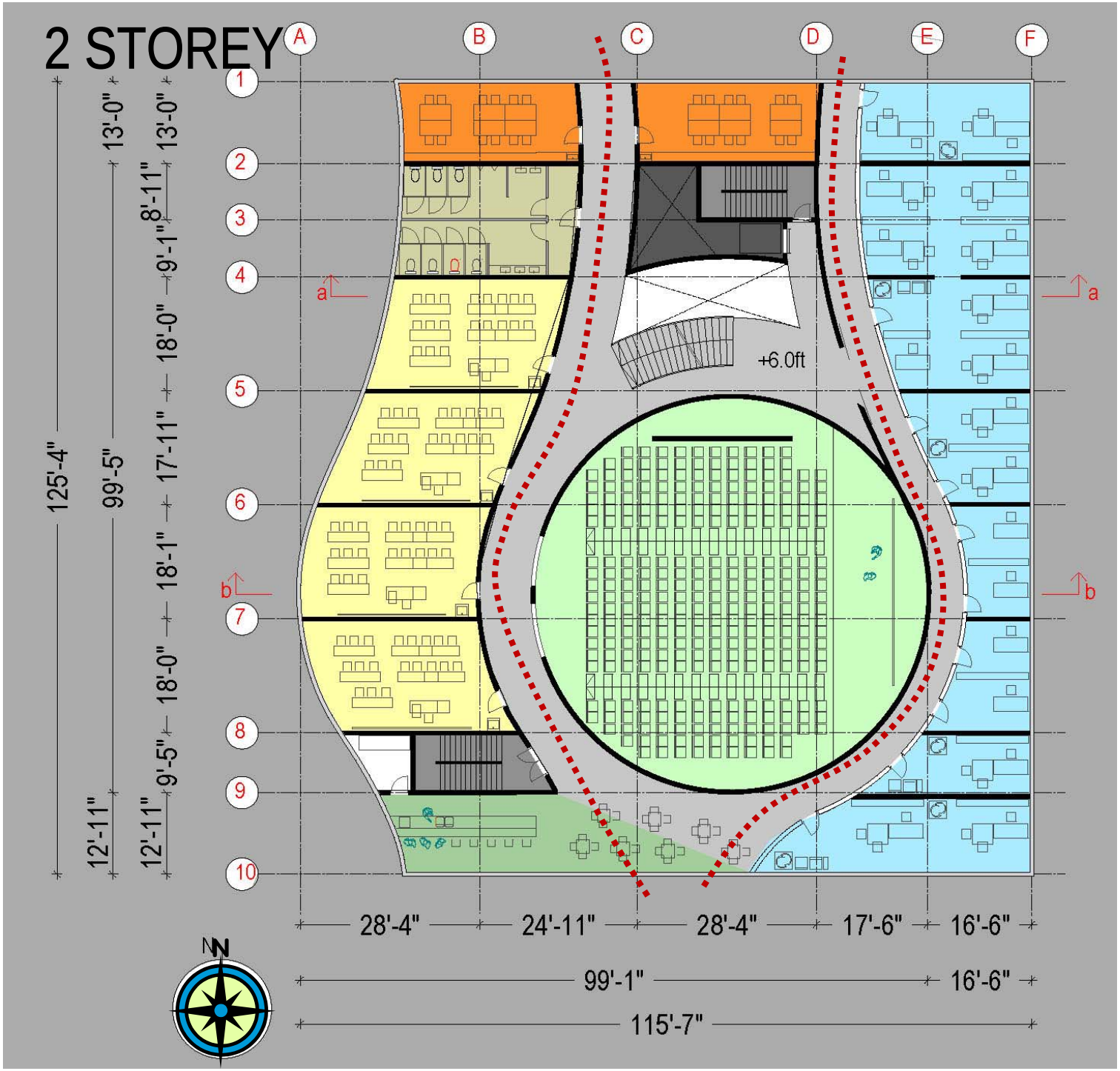
VISITORS
- AUDITORIUM
- CAFE

STUDENTS
- INSTRUCTIONAL LABS
- SMALL CLASSROOMS
- LARGE CLASSROOMS
- SEMINAR ROOMS
- STUDENT OFFICES

FACULTY
- FACULTY OFFICES
- SPECIAL OFFICES
- FACULTY LOUNGE

WAVE

2 STOREY



SERVICES
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- MECHANICAL SCHAFT
- STAIRS
- RESTROOMS

VISITORS
- AUDITORIUM
- CAFE

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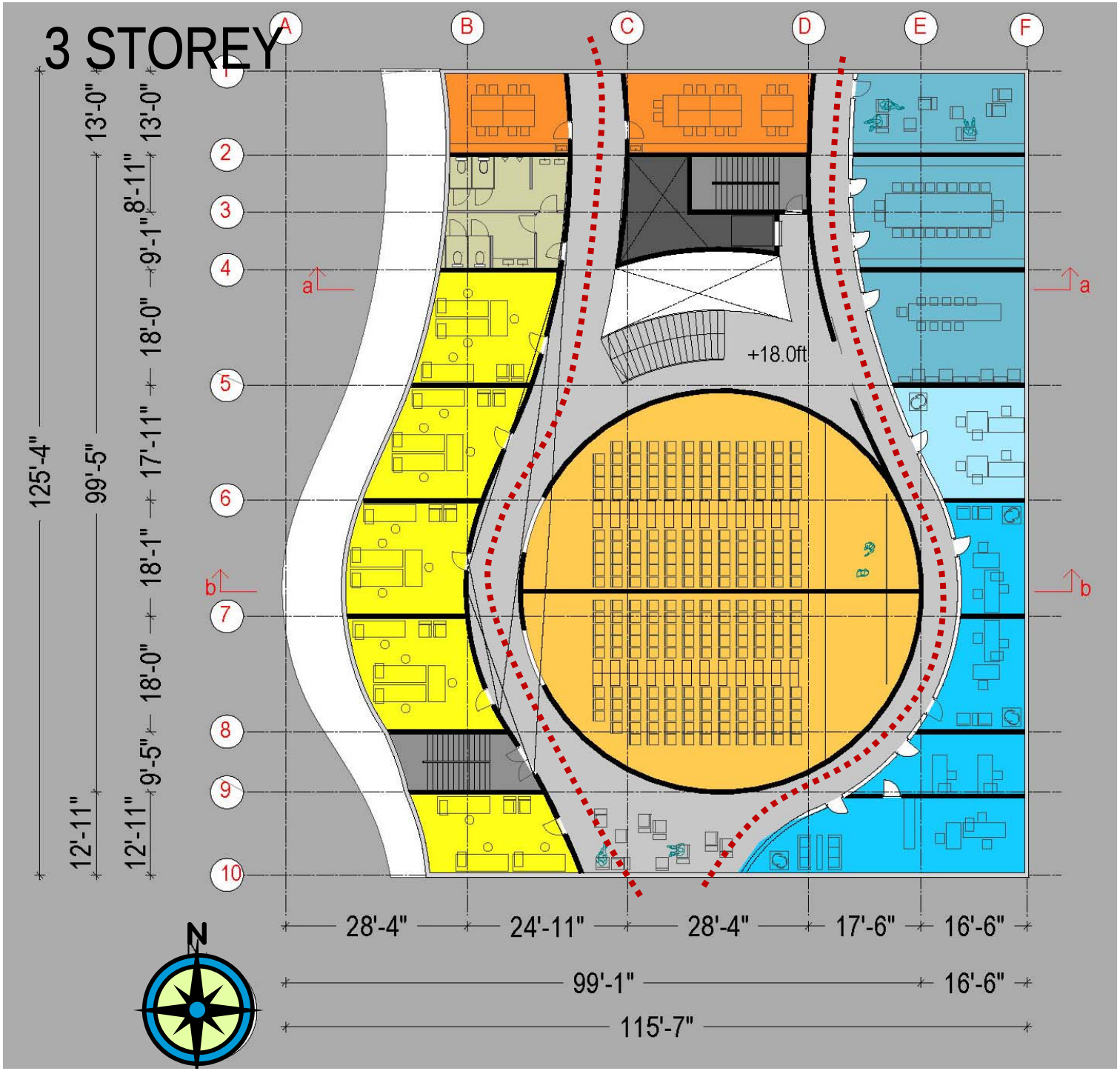
- STUDENT OFFICES

FACULTY
- FACULTY OFFICES
- SPECIAL OFFICES
- FACULTY LOUNGE

WAVE

3 STOREY



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- CAFE

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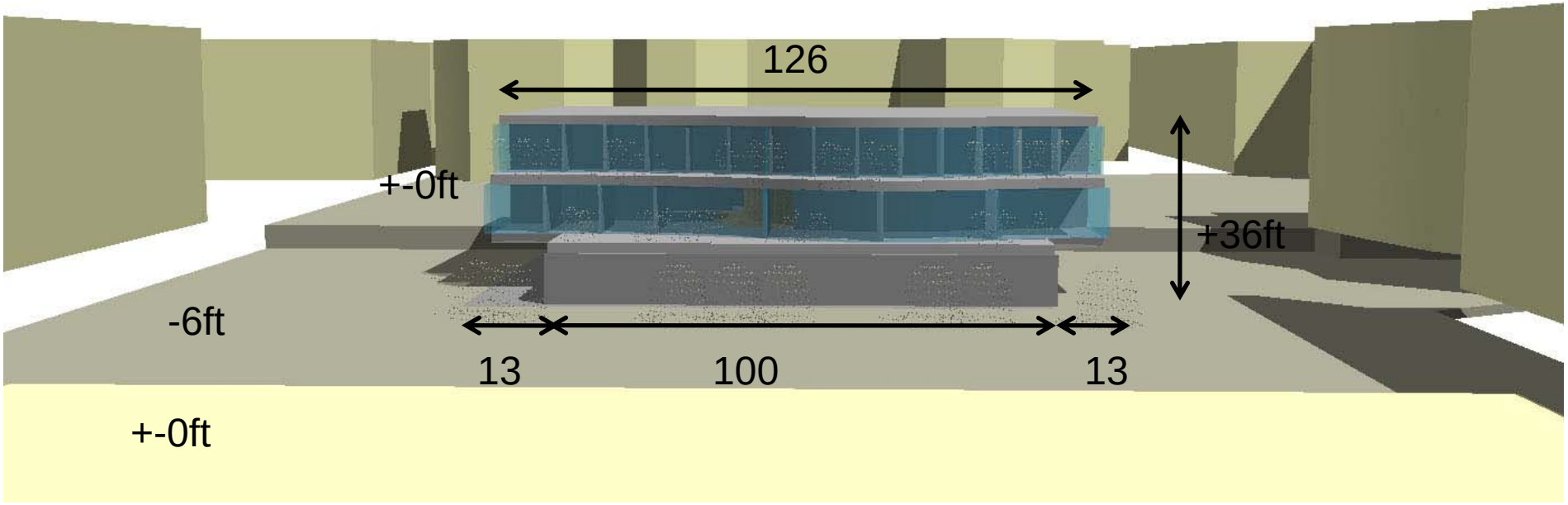
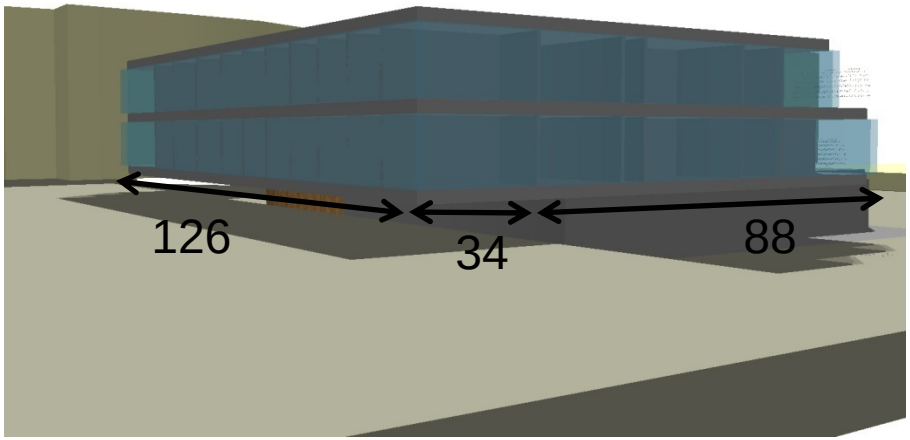
- STUDENT OFFICES

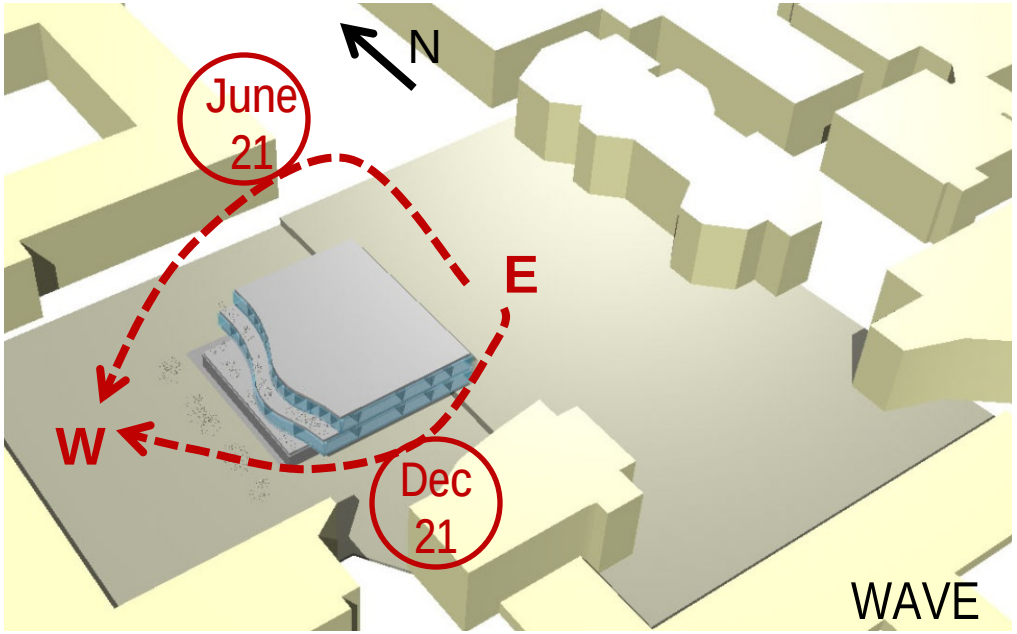
FACULTY
- FACULTY OFFICES
- SPECIAL OFFICES
- FACULTY LOUNGE

WAVE

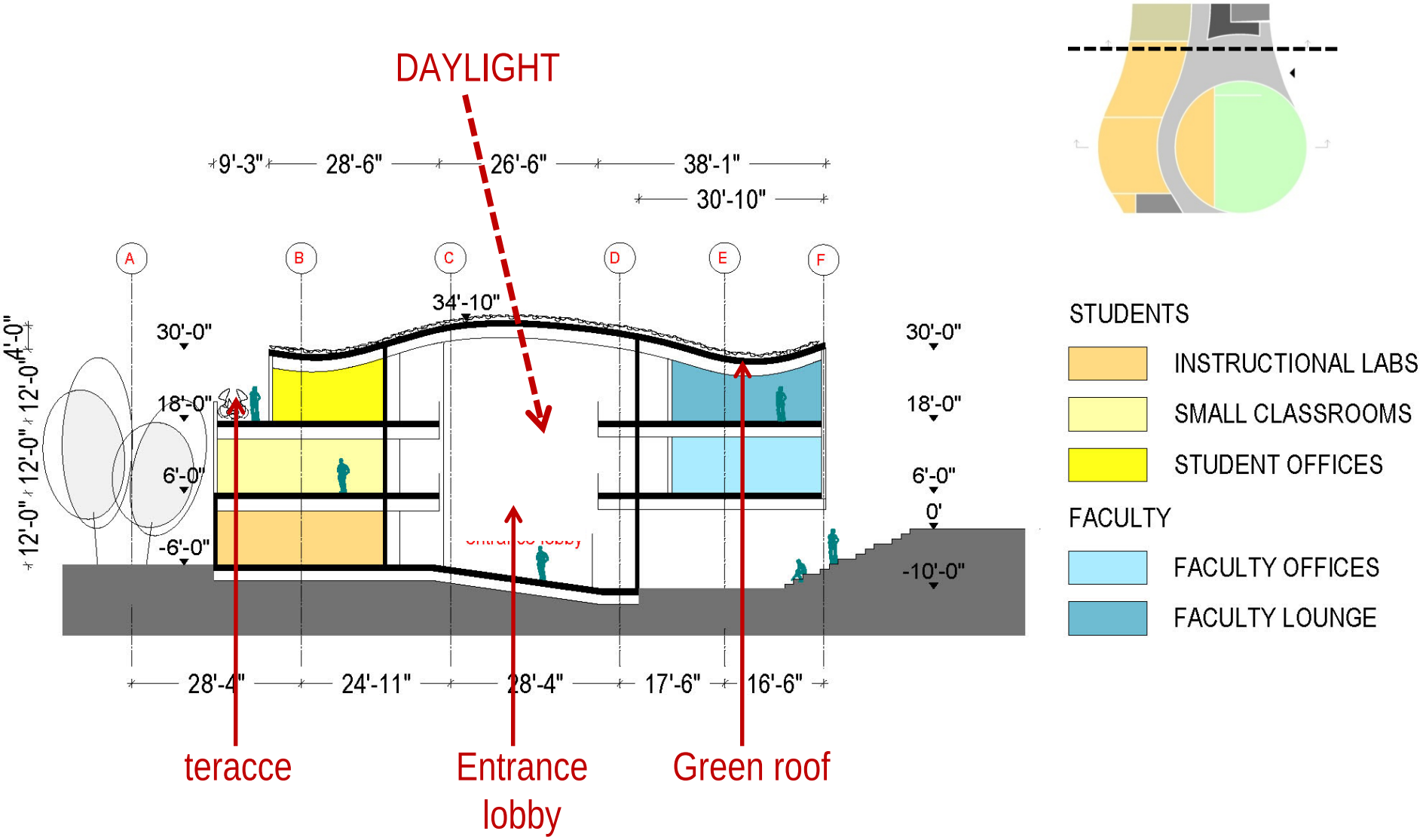
3D MODEL





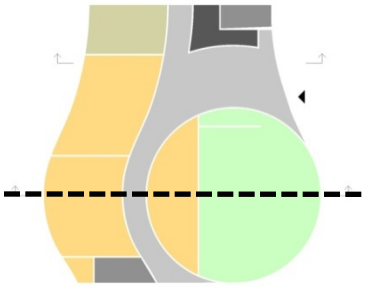


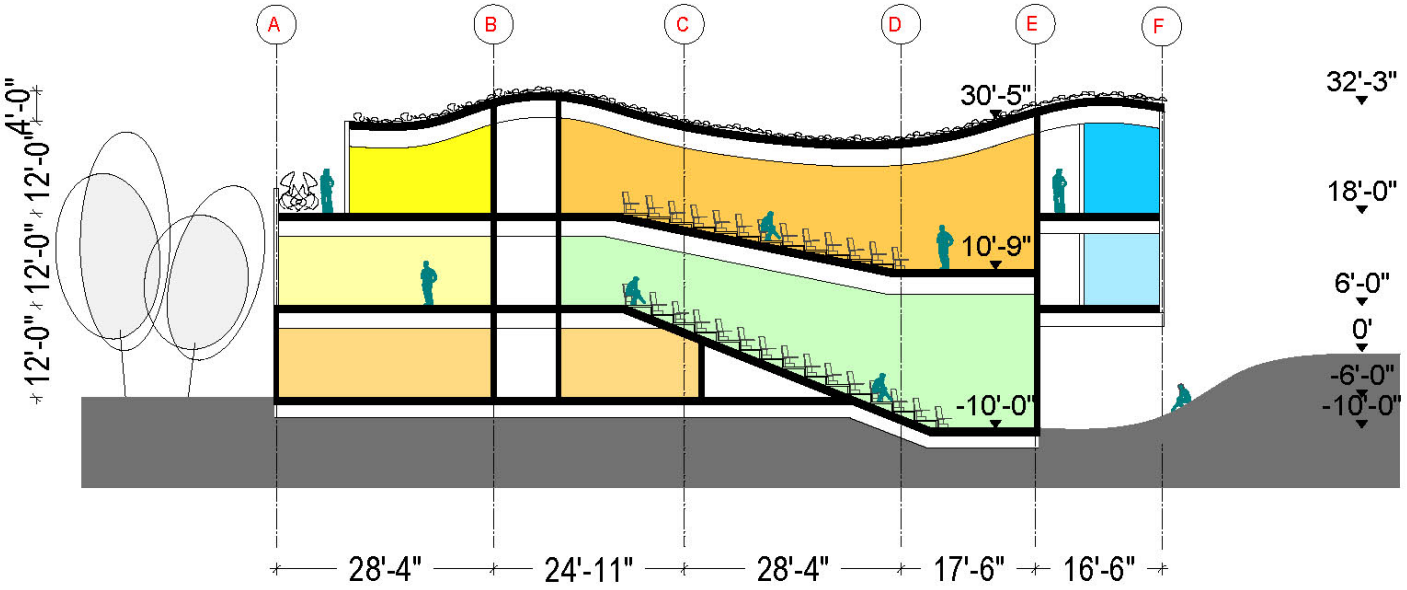
SECTION a-a



WAVE

SECTION b-b





VISITORS

AUDITORIUM

STUDENTS

INSTRUCTIONAL LABS

SMALL CLASSROOMS

LARGE CLASSROOMS

STUDENT OFFICES

FACULTY

FACULTY OFFICES

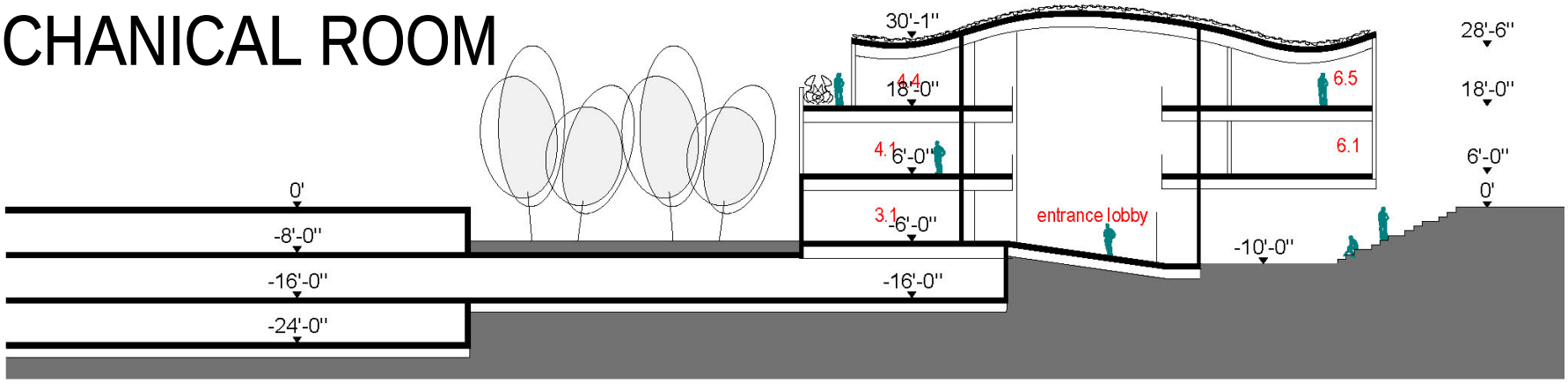
SPECIAL OFFICES

WAVE

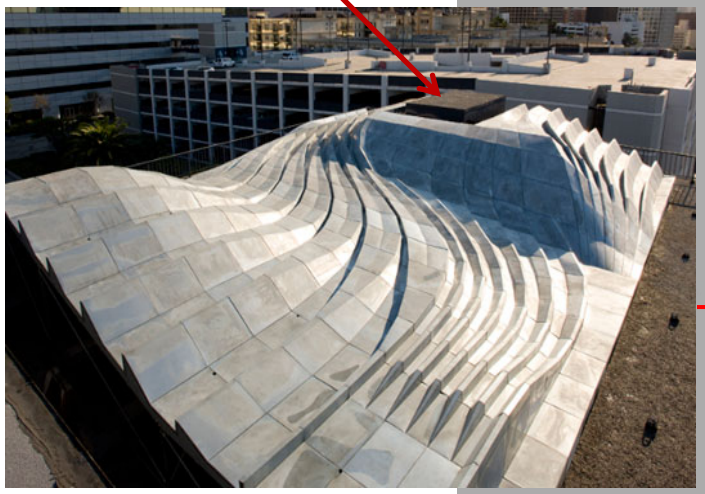
CURVY ROOF

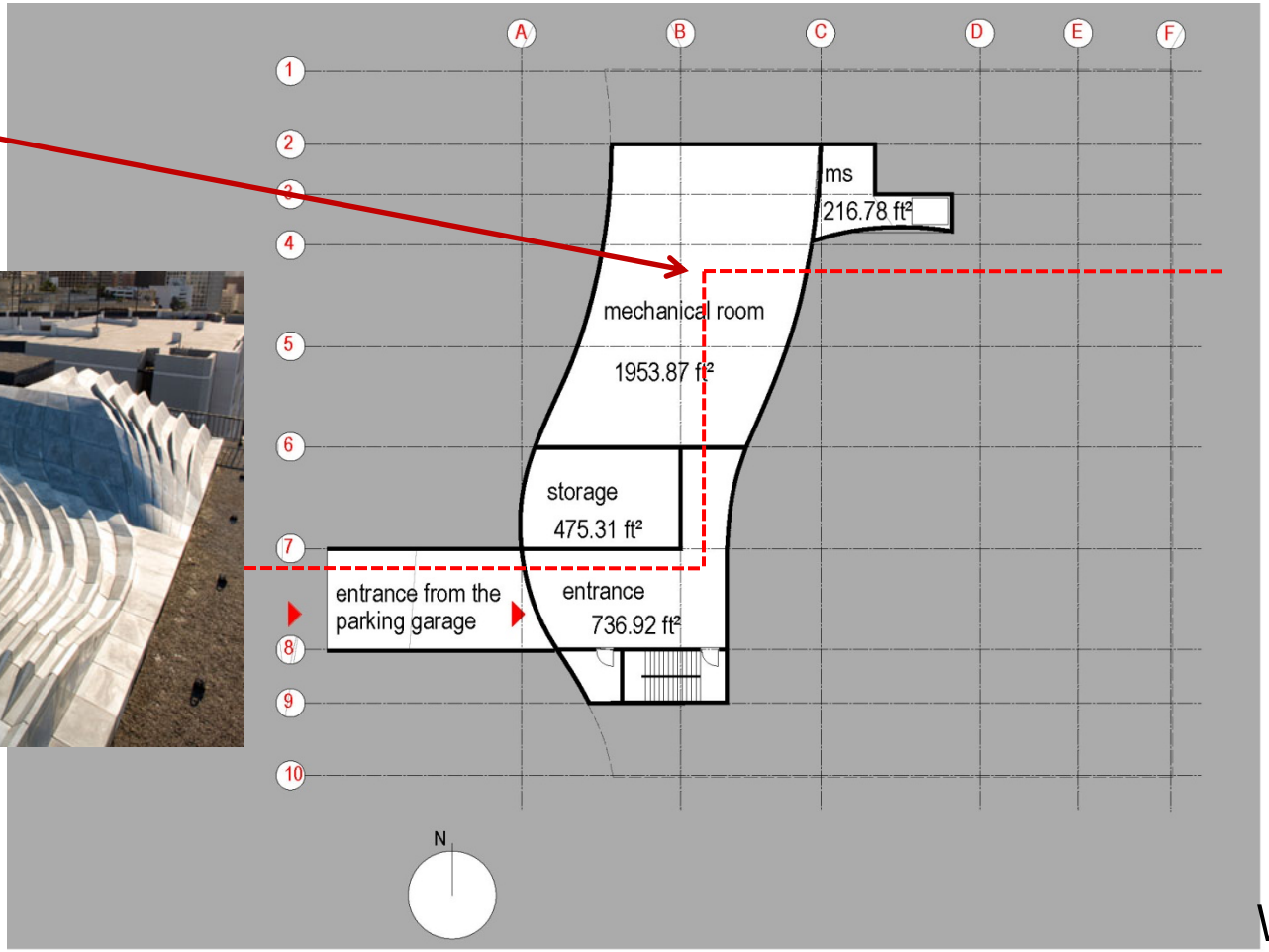
SYNTHe: An Urban Rooftop Garden Prototype in Los Angeles

MECHANICAL ROOM



a) basement
b) on the roof



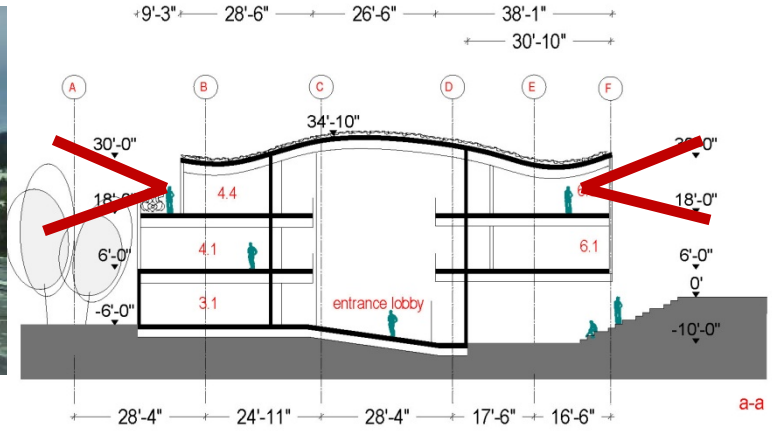


WAVE

ORIENTATION AND SHADING

- MAINTAIN THE VIEWS

W



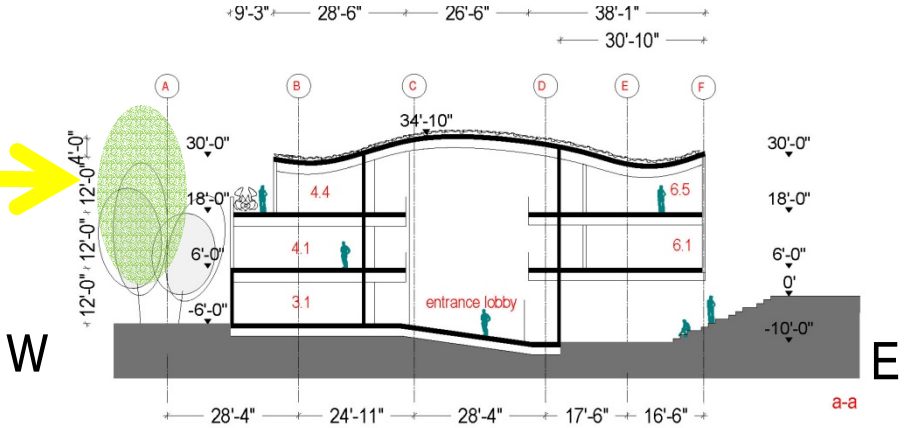
E

WAVE

ORIENTATION AND SHADING

- TREES

sun



- VERTICAL SUNSCREENS

FACADE

Level 1 – CONCRETE
Level 2 & 3 – HALF-TRANSPARENT MATERIAL with Vertical Sunscreens

Laban Centre in London, Herzog & de Meuron
POLYCARBONAT

Orestad Gimnasium, Denmark
VERTICAL SCREENS

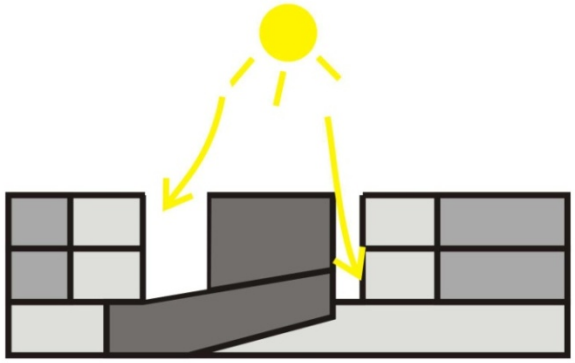
WAVE

2 CONCEPT – big idea 1

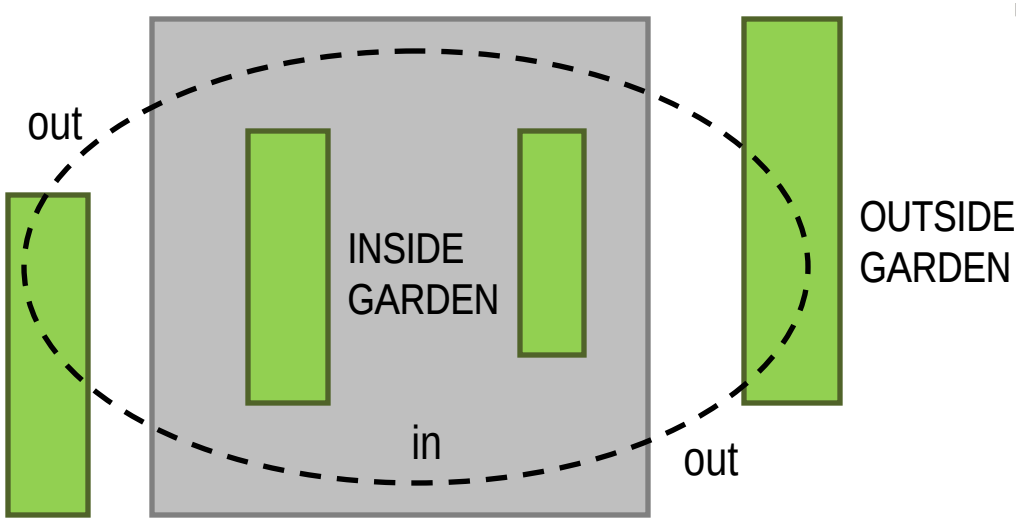
NATURE

losing nature....

giving back the nature....



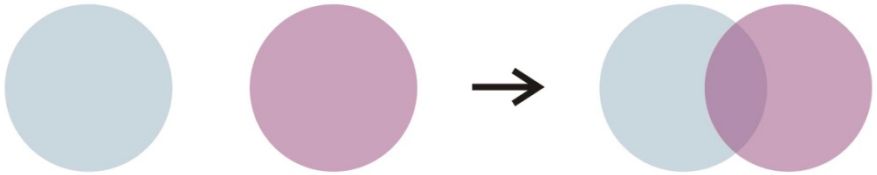
...bringing daylight in the building - PATIOS



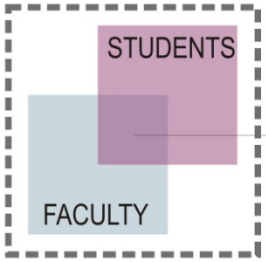
...connecting outside and inside greener space

2 CONCEPT – big idea 2

TWO HANDS

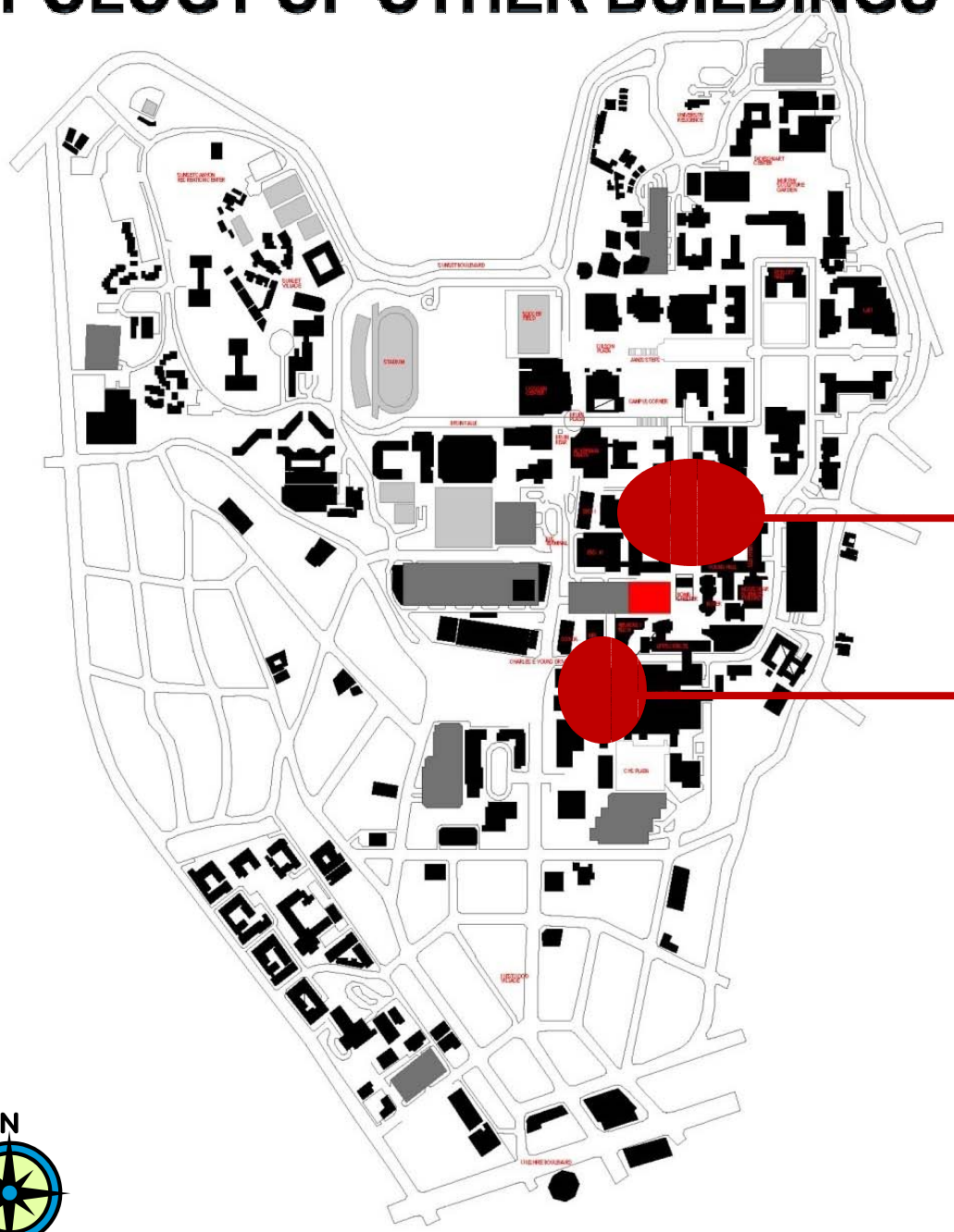


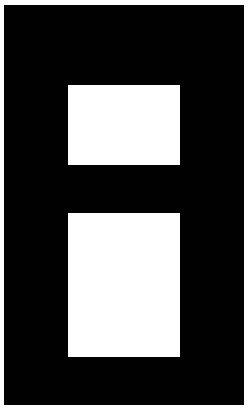
2 GROUPS OF PEOLPE
2 PROGRAMMS
need/wish to be alone & togehter



VISITORS -
AUDITORIUM

TYPOLOGY OF OTHER BUILDINGS



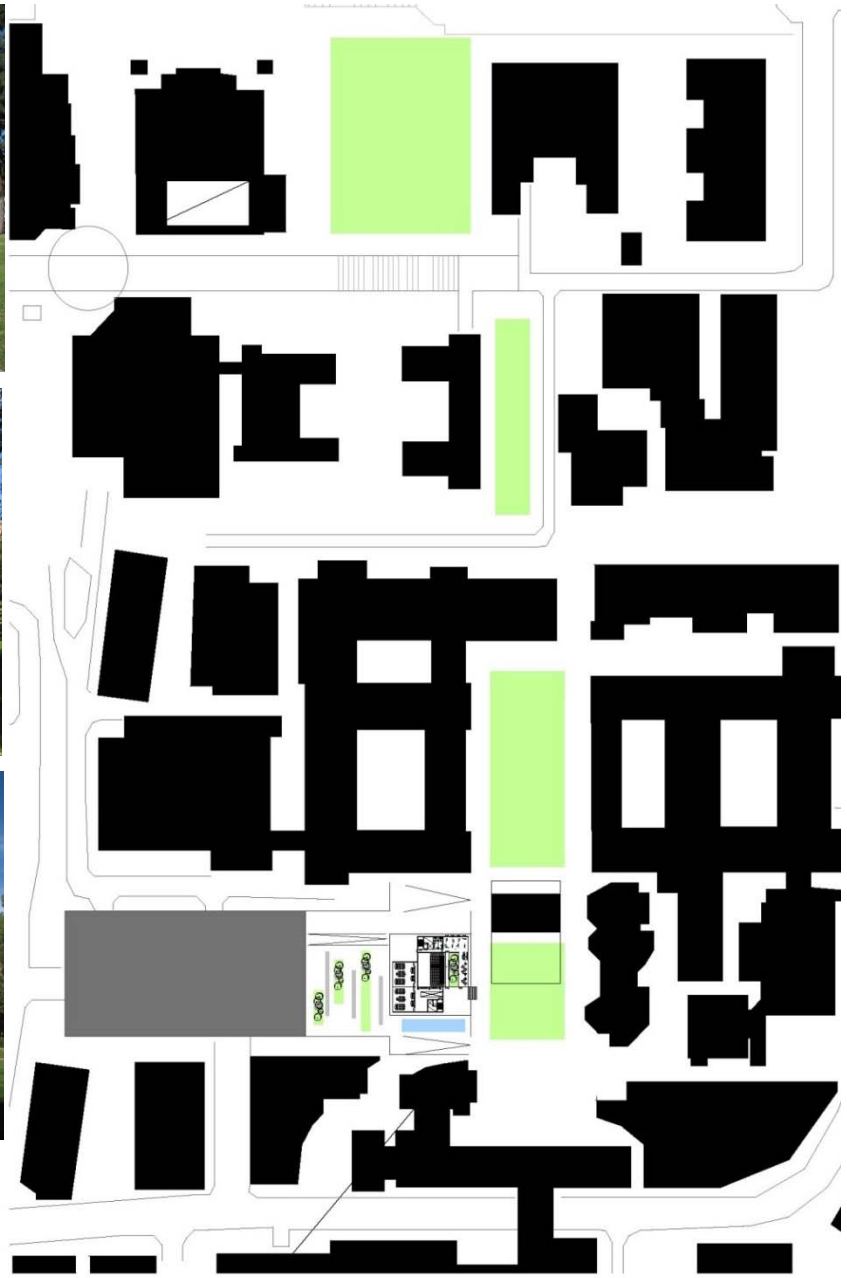


CONCEPT OF ATRIUMS

N

NATURE

PARKS IN UCLA

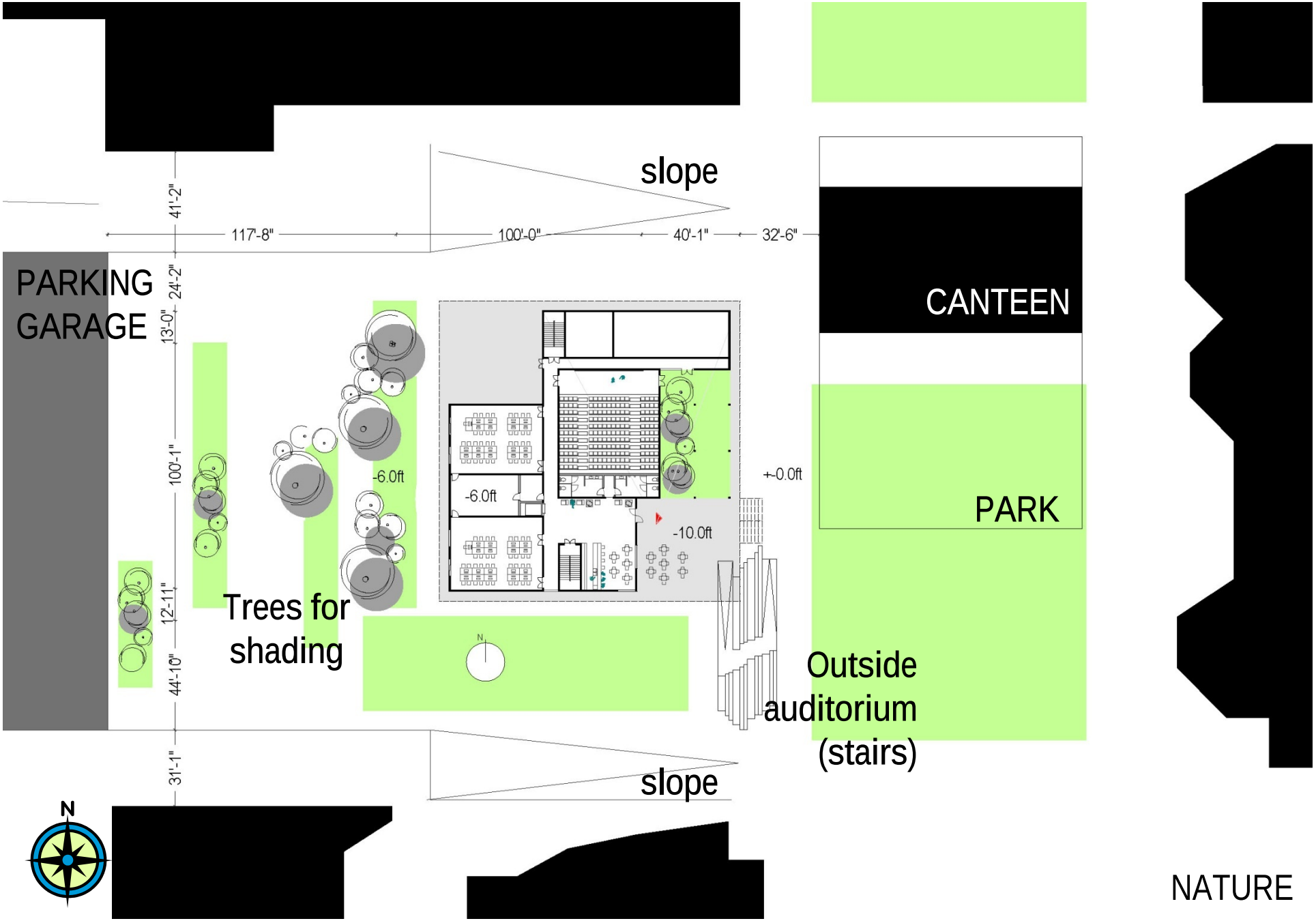


NATURE

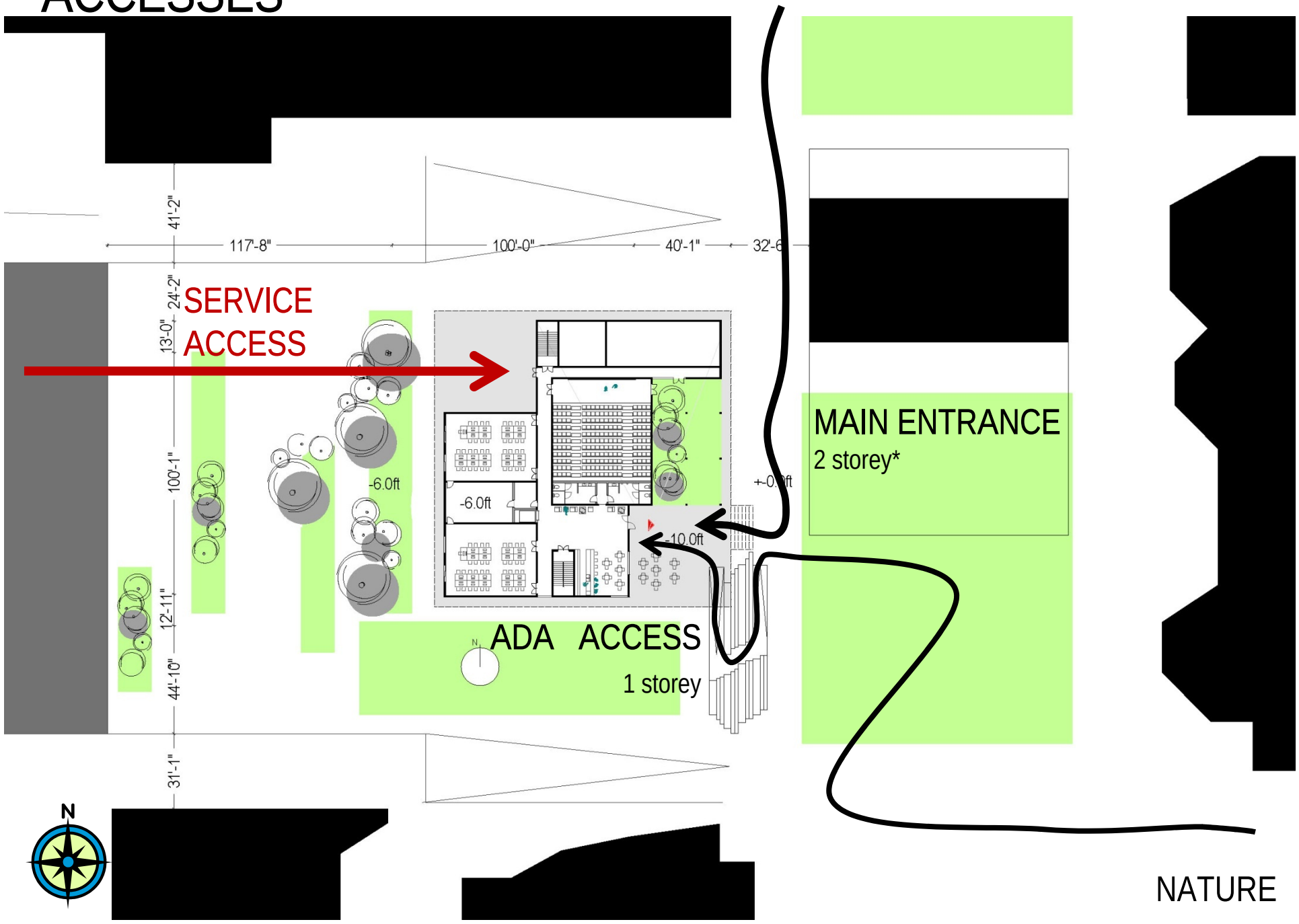
ACCESSES

NATURE

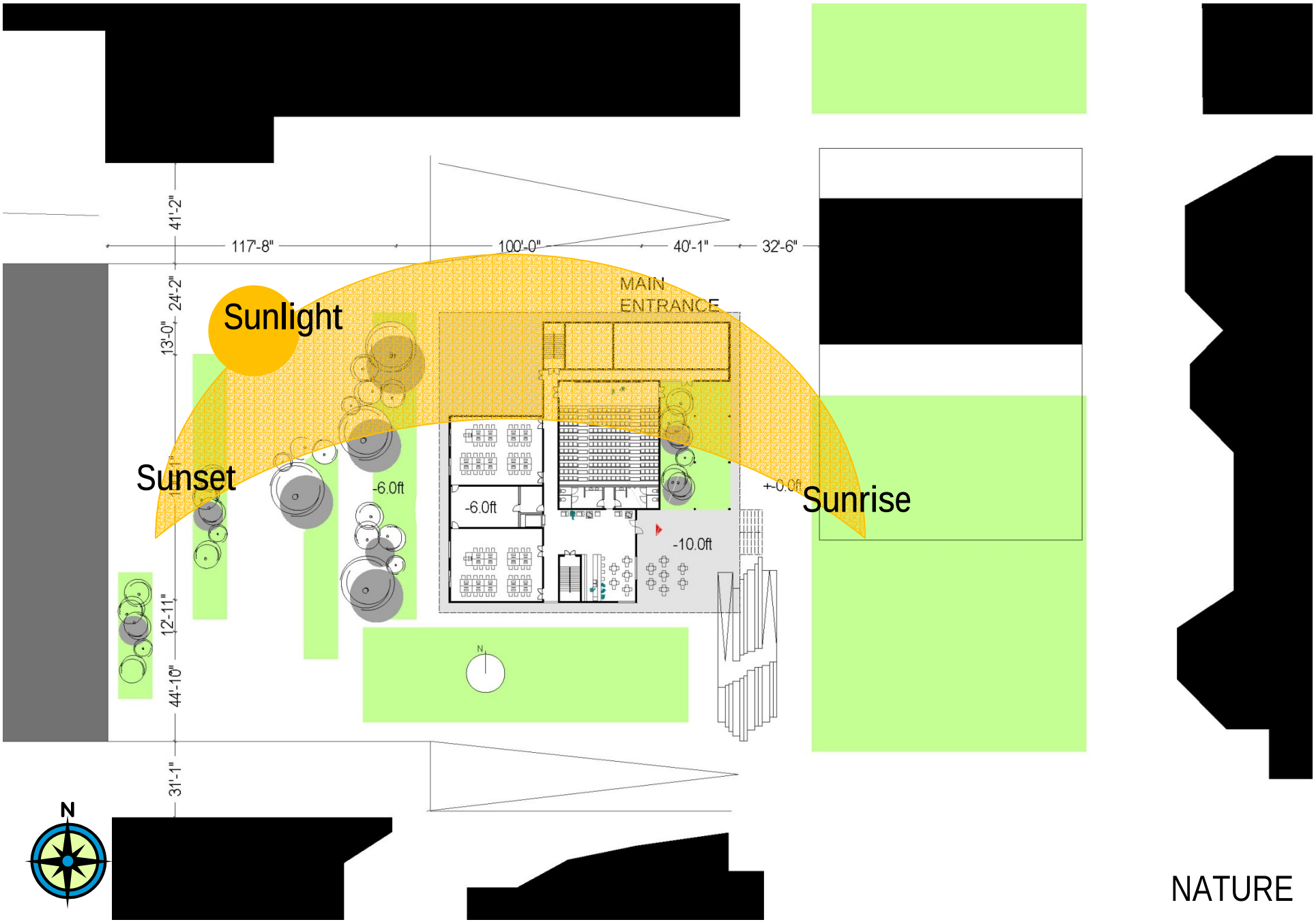
LANDSCAPING AND SORROUNDINGS



ACCESSES


41'-2"
117'-8"
100'-0"
40'-1"
32'-6
24'-2"
13'-0"
SERVICE
ACCESS
100'-1"
-6.0ft
-6.0ft
+-0.0ft
-10.0ft
MAIN ENTRANCE
2 storey*
12'-11"
44'-10"
ADA ACCESS
1 storey
31'-1"
N
NATURE

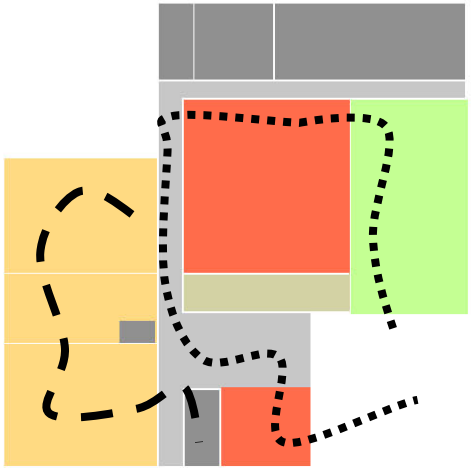
ORIENTATION - SUN



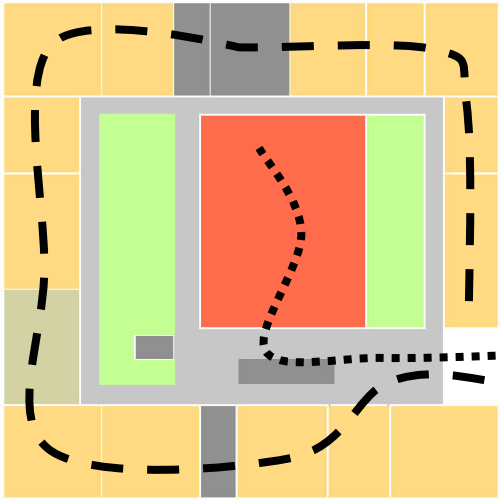
NATURE

ACTIVITY MODEL

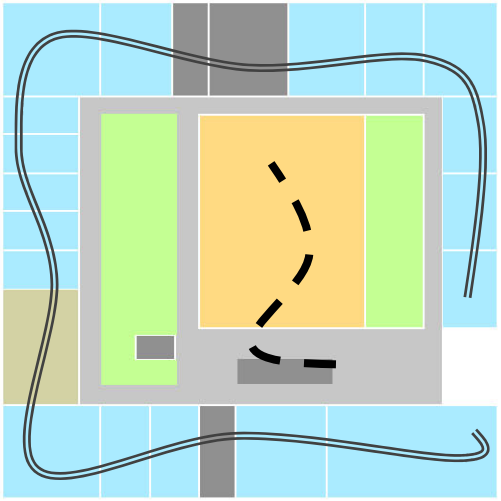
1 STOREY

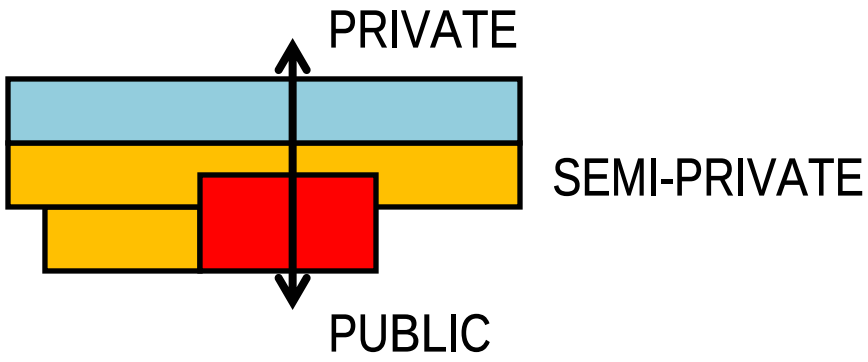


2 STOREY



3 STOREY





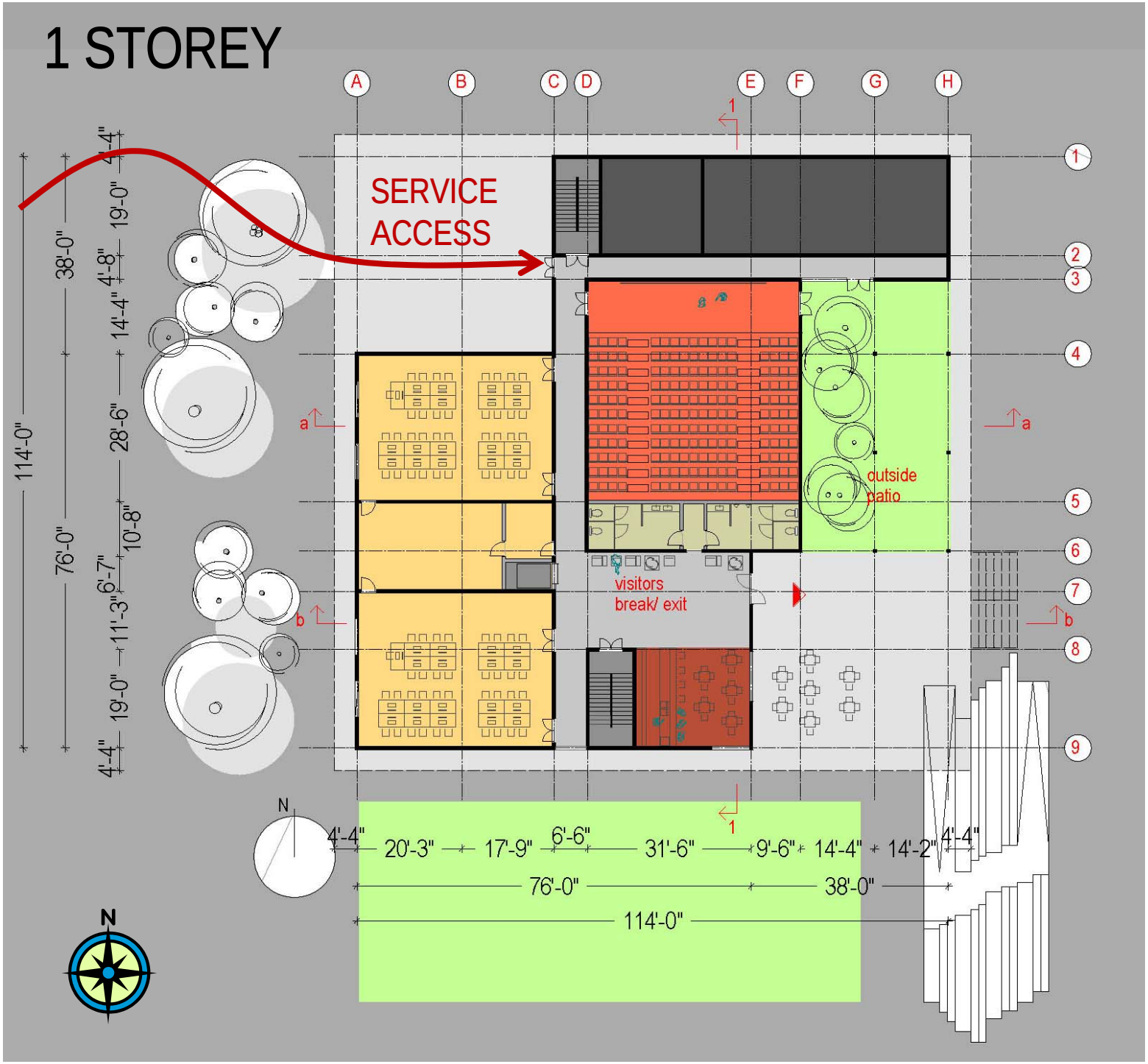
STUDENTS

VISITORS

FACULTY

NATURE

1 STOREY



SERVICES
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- MECHANICAL SCHAFT
- STAIRS
- RESTROOMS

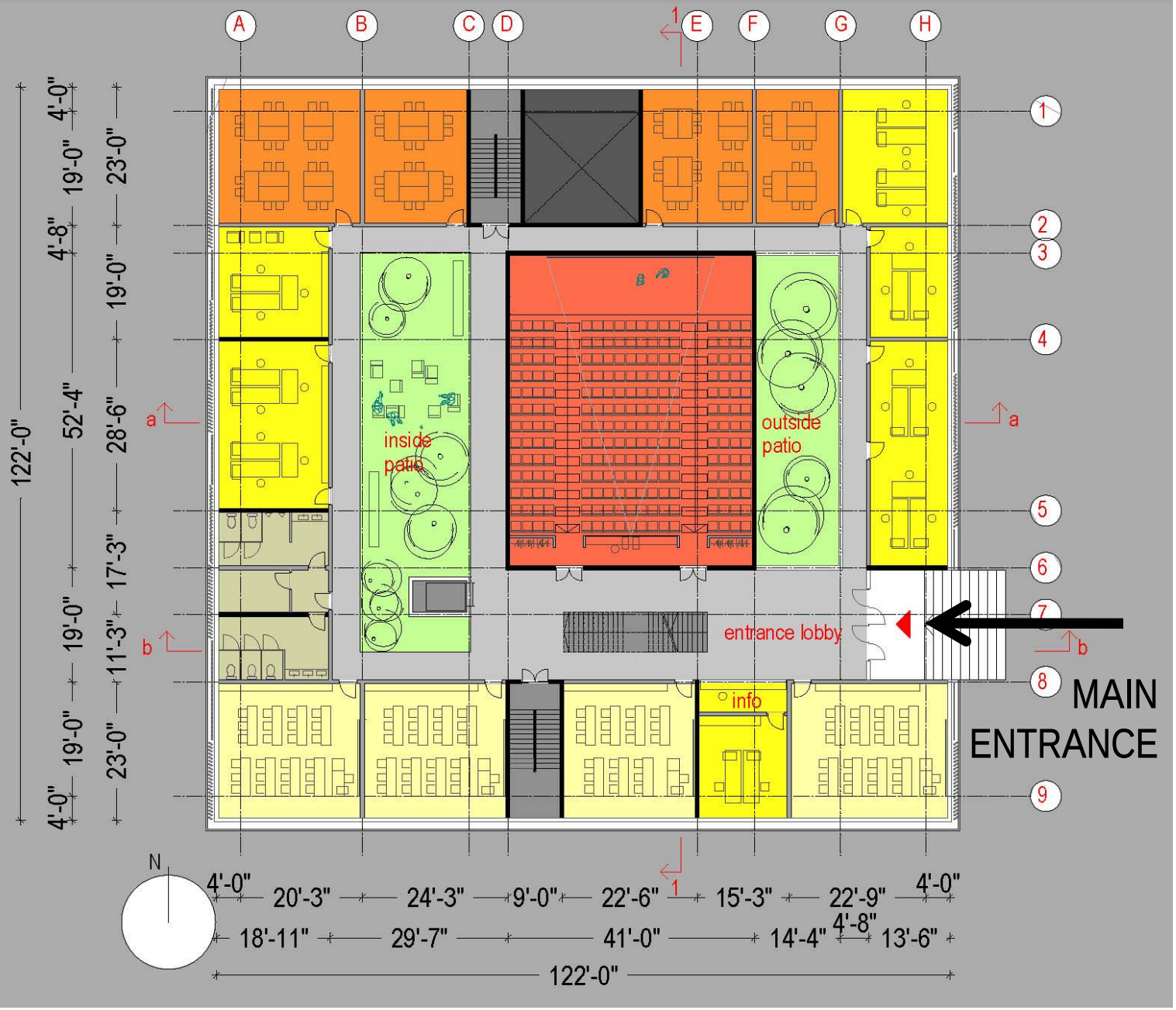
VISITORS
- AUDITORIUM
- CAFE

STUDENTS
- INSTRUCTIONAL LABS
- SMALL CLASSROOMS
- LARGE CLASSROOMS
- SEMINAR ROOMS
- STUDENT OFFICES

FACULTY
- FACULTY OFFICES
- SPECIAL OFFICES
- FACULTY LOUNGE

NATURE

2 STOREY



SERVICES
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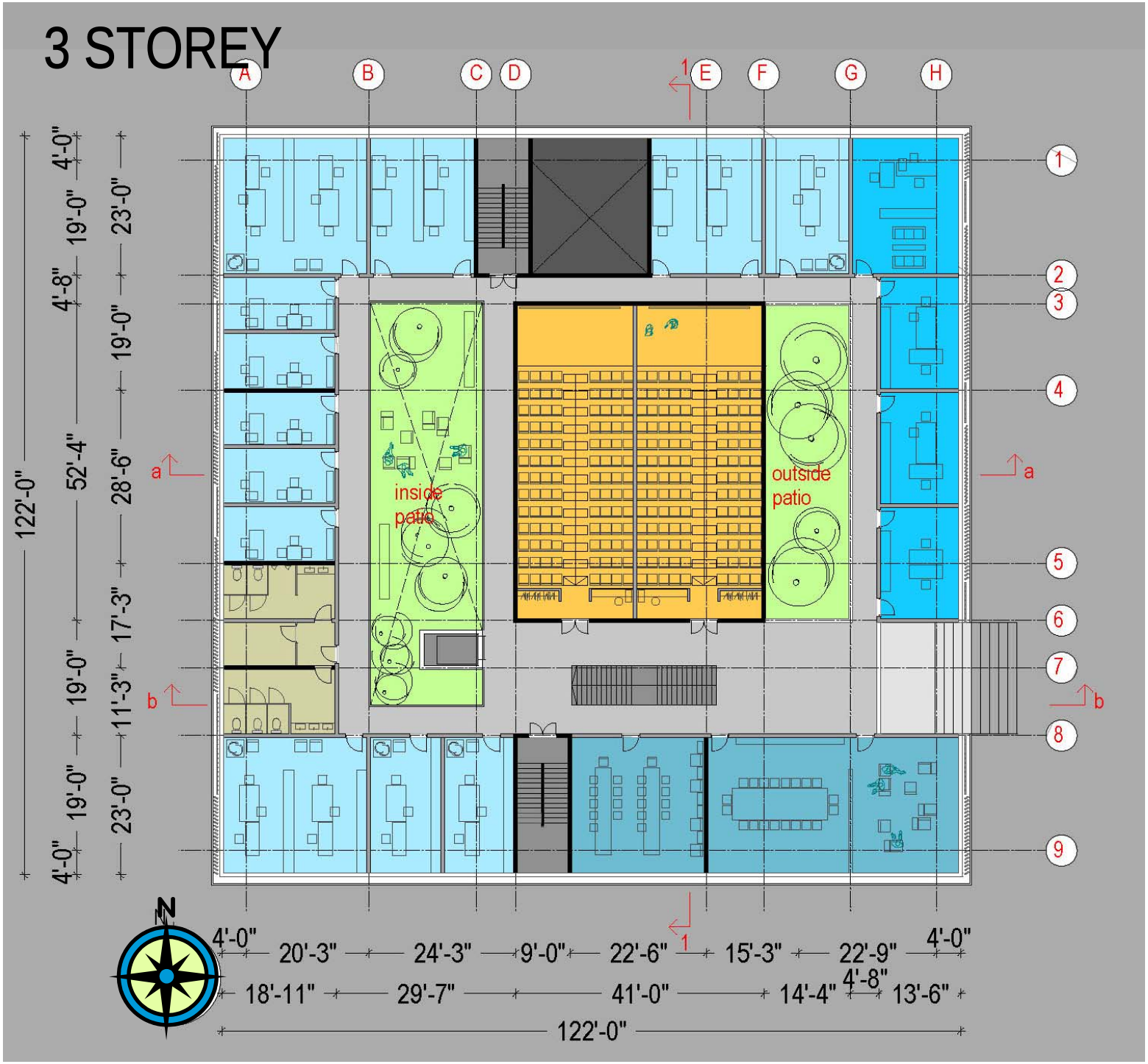
- INSTRUCTIONAL LABS
- SMALL CLASSROOMS
- LARGE CLASSROOMS
- SEMINAR ROOMS
- STUDENT OFFICES

FACULTY
- FACULTY OFFICES
- SPECIAL OFFICES
- FACULTY LOUNGE

NATURE

3 STOREY



SERVICES
- CORRIDORS
- MECHANICAL SCHAFT
- STAIRS
- RESTROOMS

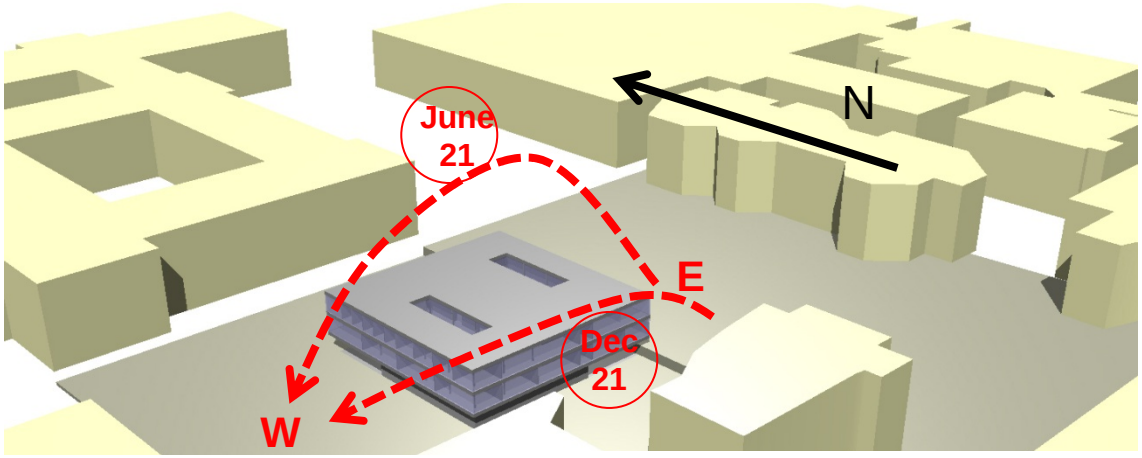
VISITORS
- AUDITORIUM
- CAFE

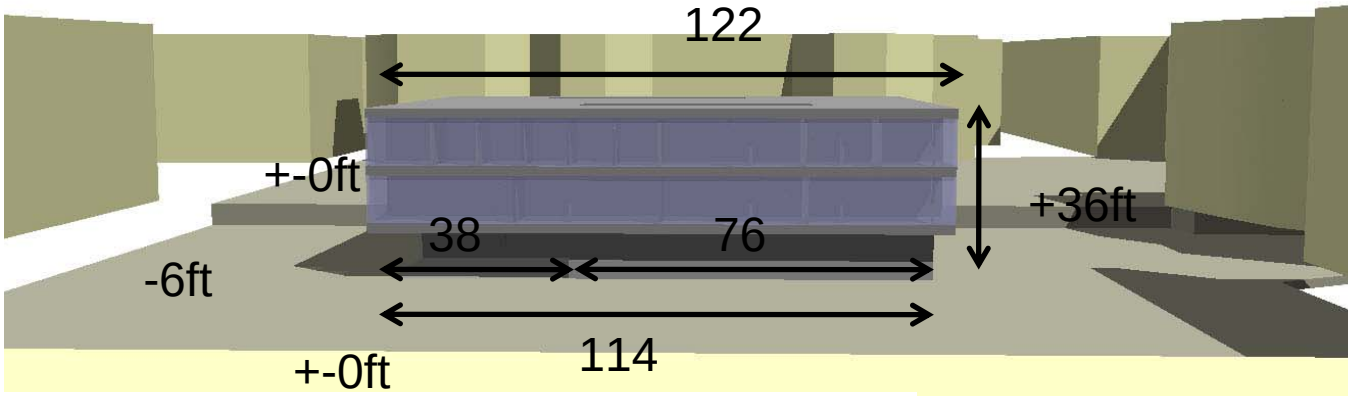
STUDENTS
- INSTRUCTIONAL LABS
- SMALL CLASSROOMS
- LARGE CLASSROOMS
- SEMINAR ROOMS
- STUDENT OFFICES

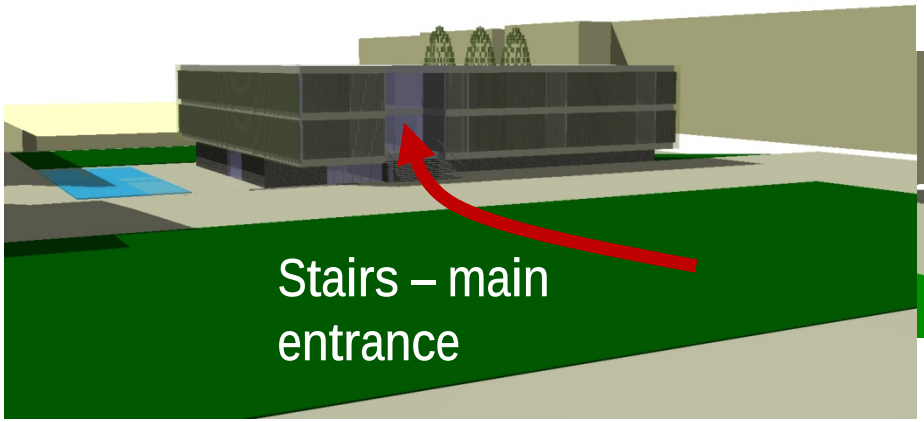
FACULTY
- FACULTY OFFICES
- SPECIAL OFFICES
- FACULTY LOUNGE

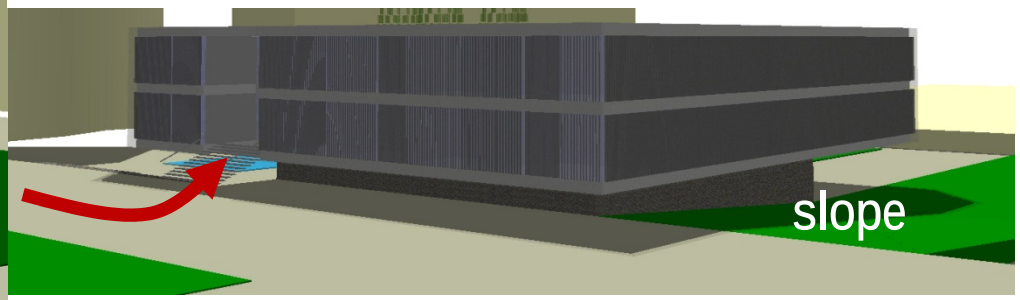
NATURE

3D MODEL



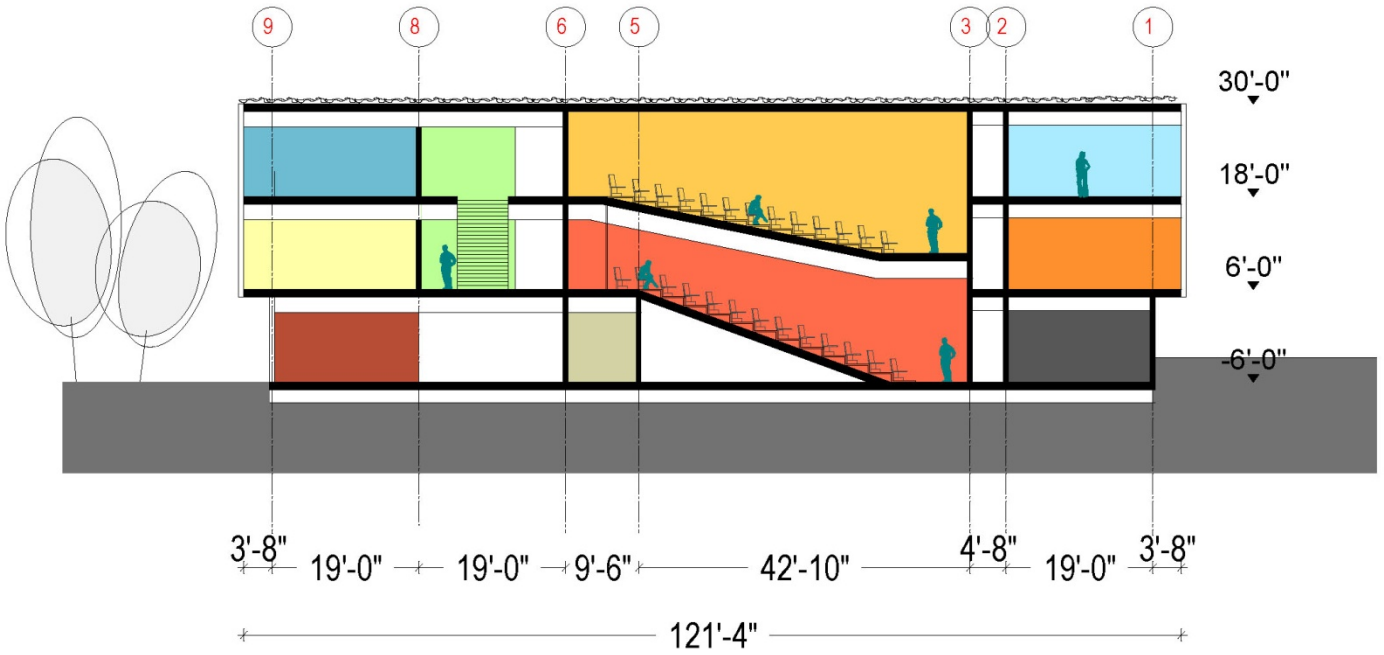


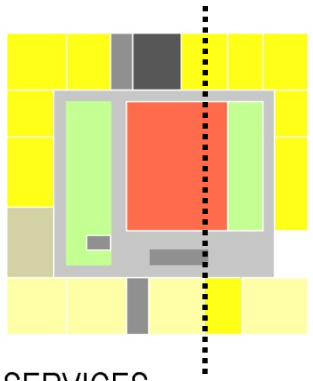




NATURE

SECTION 1-1





SERVICES

MECHANICAL ROOM

RESTROOMS

VISITORS

AUDITORIUM

CAFE

STUDENTS

SMALL CLASSROOMS

LARGE CLASSROOMS

SEMINAR ROOMS

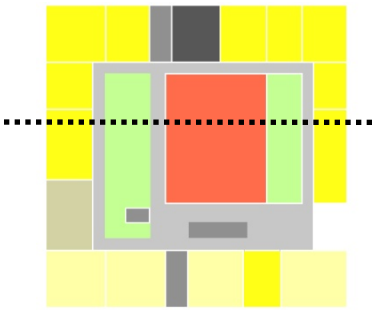
FACULTY

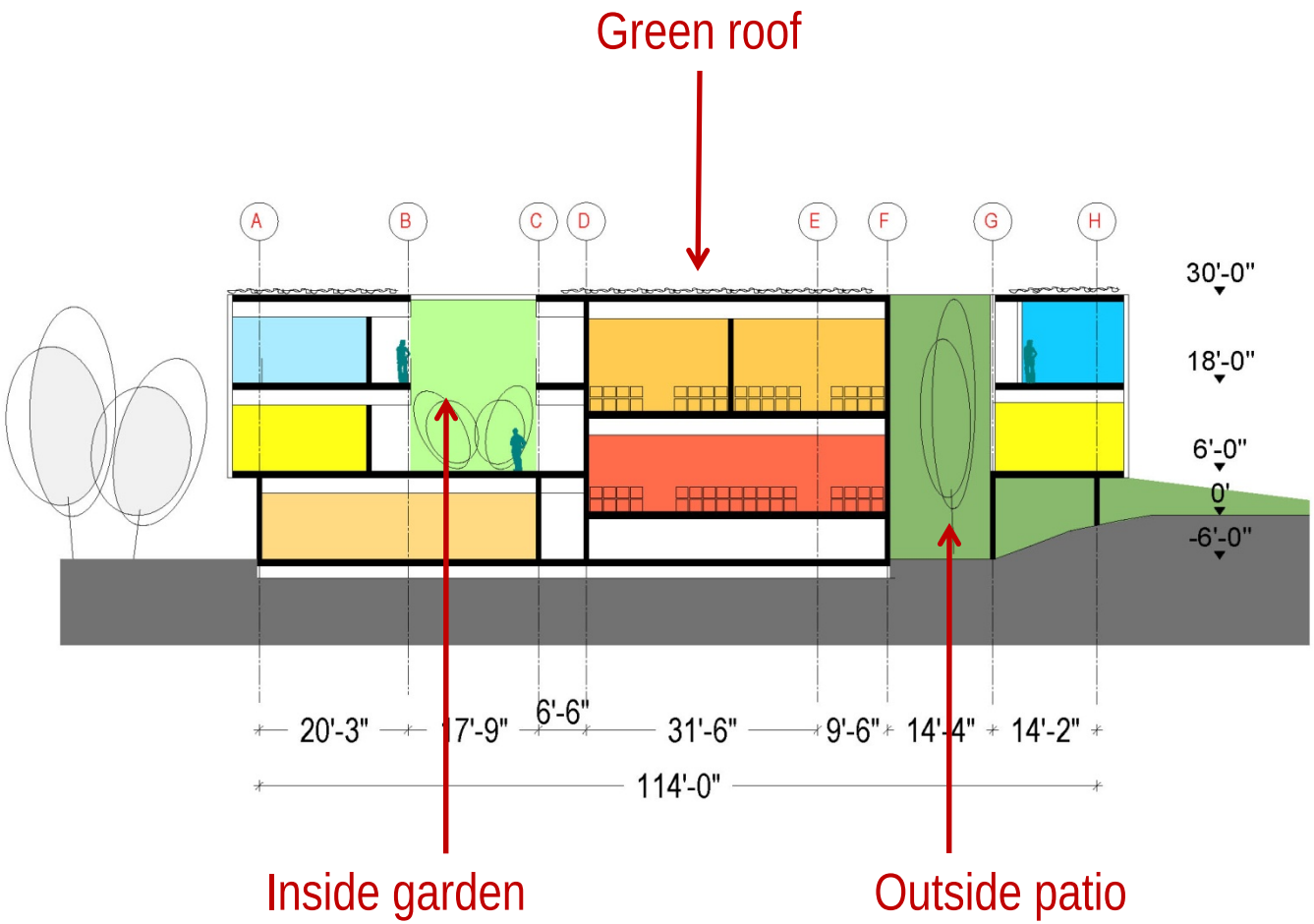
FACULTY OFFICES

FACULTY LOUNGE

NATURE

SECTION a-a





VISITORS

AUDITORIUM

STUDENTS

INSTRUCTIONAL LABS

LARGE CLASSROOMS

STUDENT OFFICES

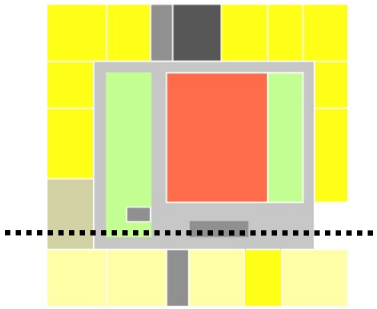
FACULTY

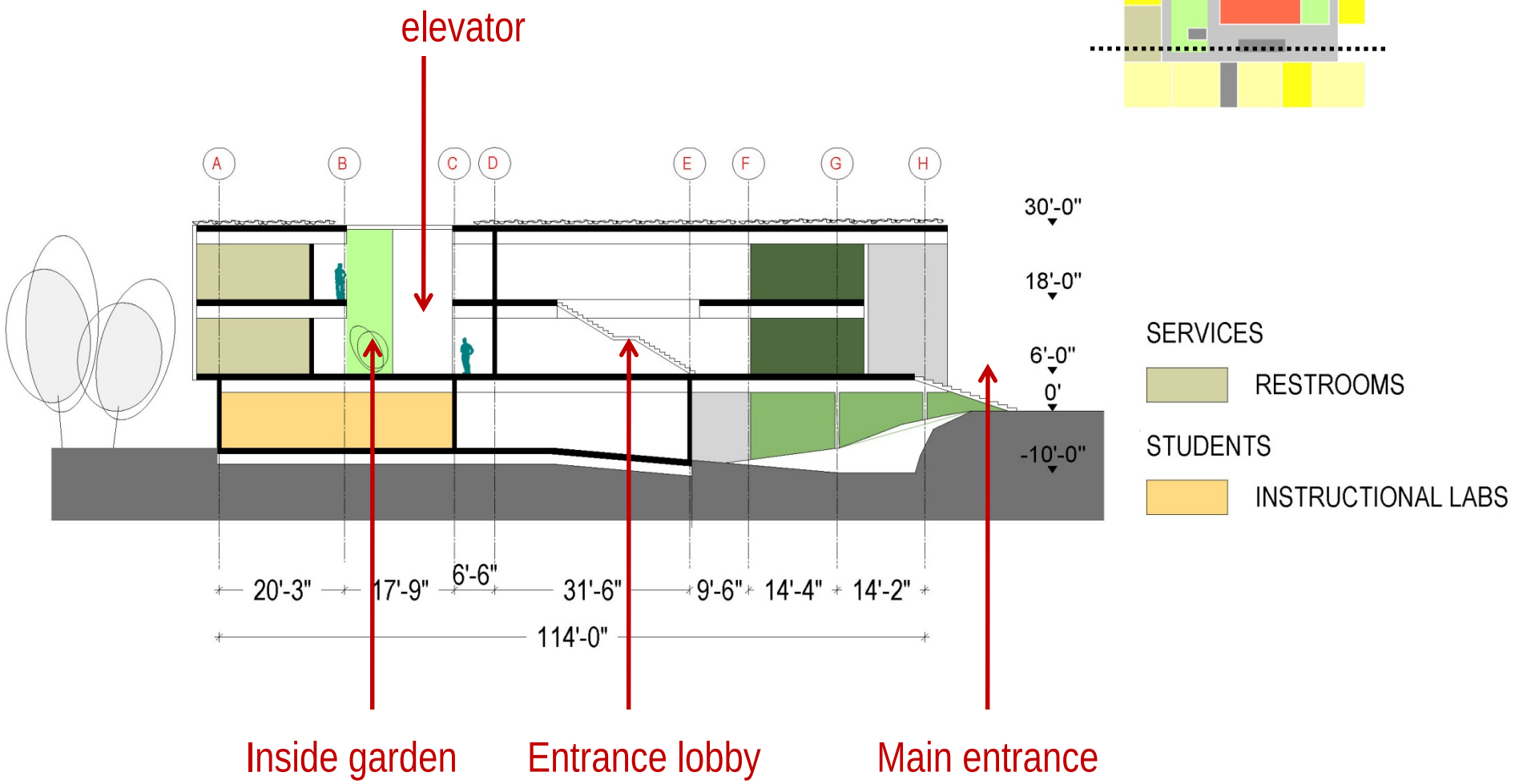
FACULTY OFFICES

SPECIAL OFFICES

NATURE

SECTION b-b

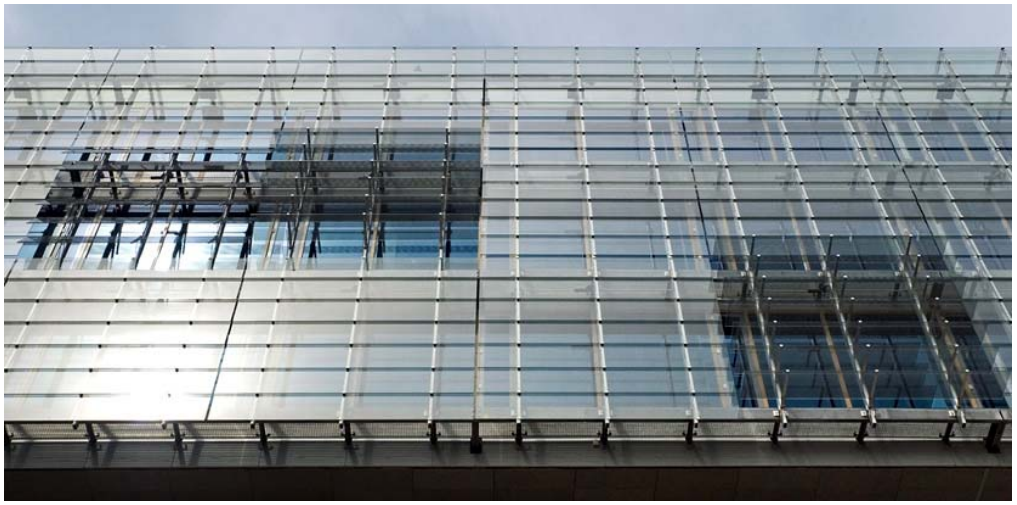


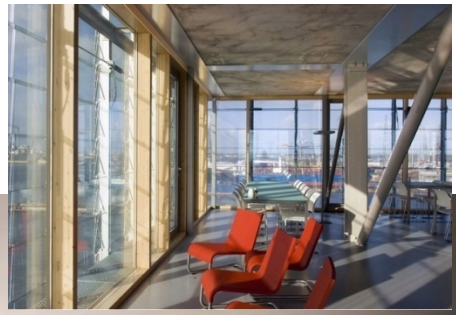


NATURE

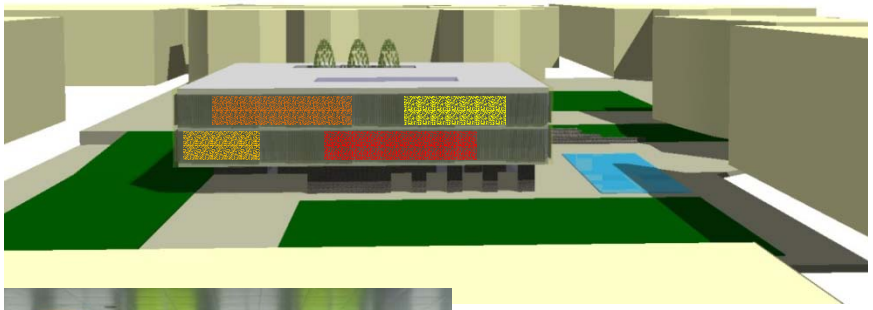
FACADE – CONCRETE + GLASS

- DOUBLE GLASSED FACADE

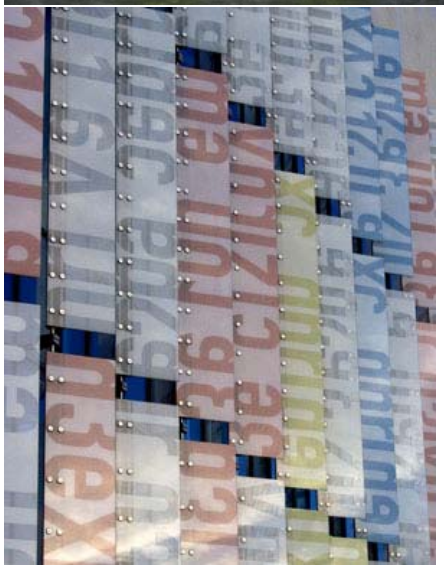




- VERTICAL SCREENS



Orestad,Denmark,
Gimnasium



EXPERIENCE IN THE BUILDING...

- LEARNING
- GLASS STAIRS AND ELEVATOR
- INSIDE GARDENS
- INSIDE PATIO

Orestad,Denmark, Gimnasium

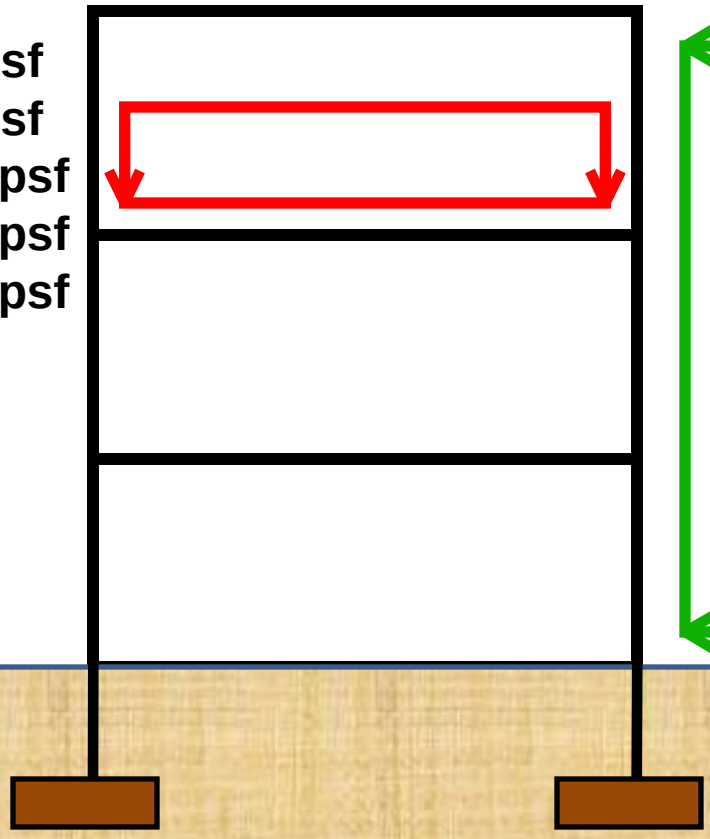
NATURE

STRUCTURAL CONCEPTS

LOADS

Live Loads:

Classrooms:	**40 psf**
Offices:	**50 psf**
Corridors:	**100 psf**
Auditorium:	**100 psf**
Roof (green):	**100 psf**



Earthquake:

Seismic Zone:	**High**
Soil Type:	**D**
S_{DS}:	**1.225**
S_{D1}:	**0.626**

Wind:

Wind Speed:	**<85mph**
Building Class:	**III**
Exposure	**B**

Soil:

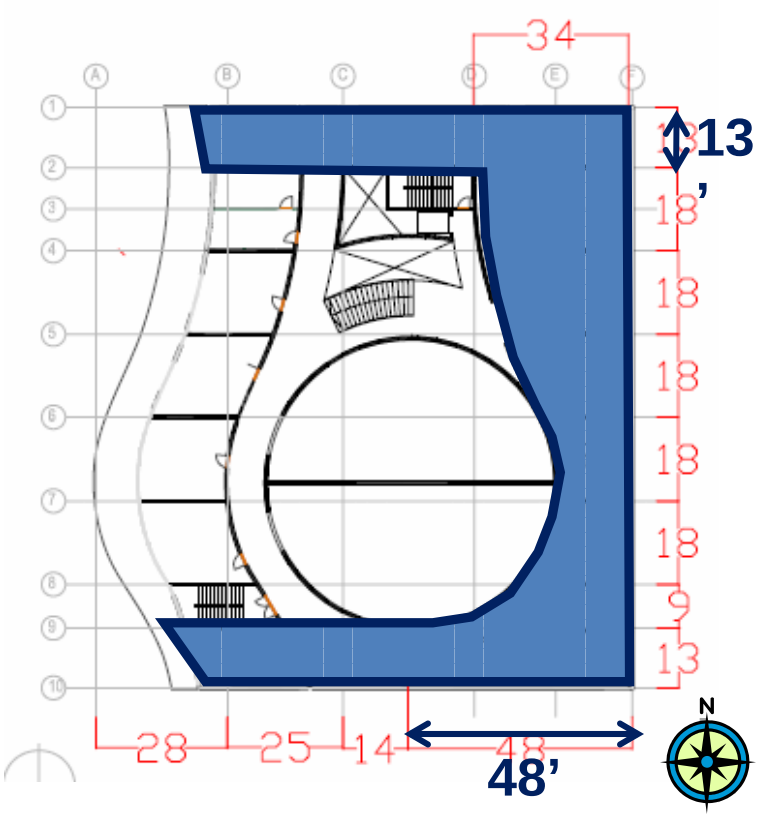
Type:	**Sandy soil**
Bearing pressure:	**5000 psf**
Water depth:	**15 ft**
Liquefaction:	**No**

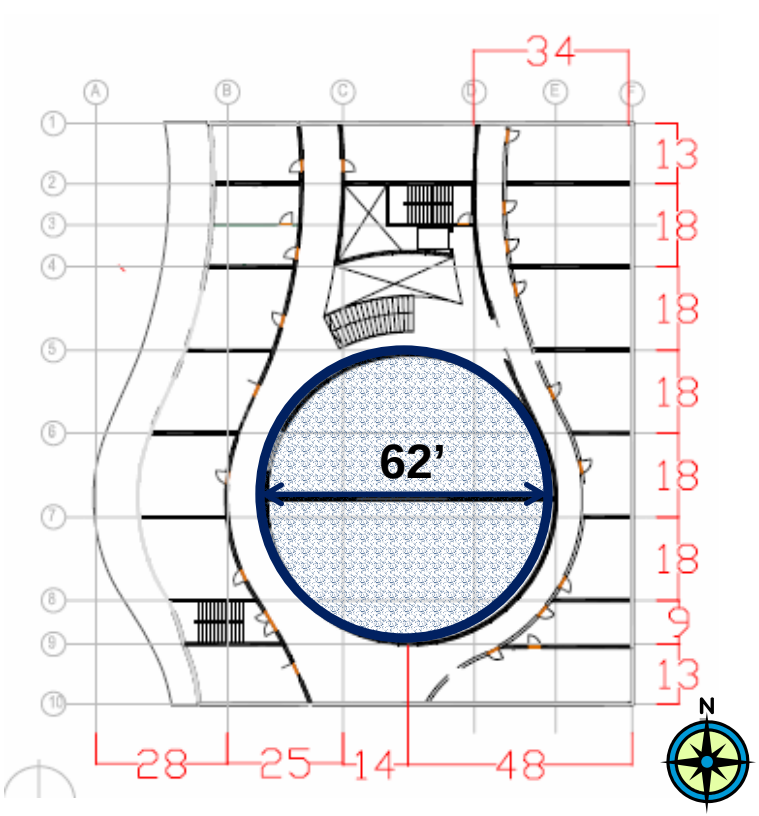
ARCHITECTURAL CONCEPT 1

WAVE

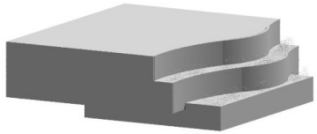
EVALUATION

- Challenges
  - ★ Two storey cantilever , 48 ft long (max)
  - ★ 62 ft span over the auditorium
  - ★ Unsymmetrical layout
- Advantages
  - ★ Strong circular closed form core

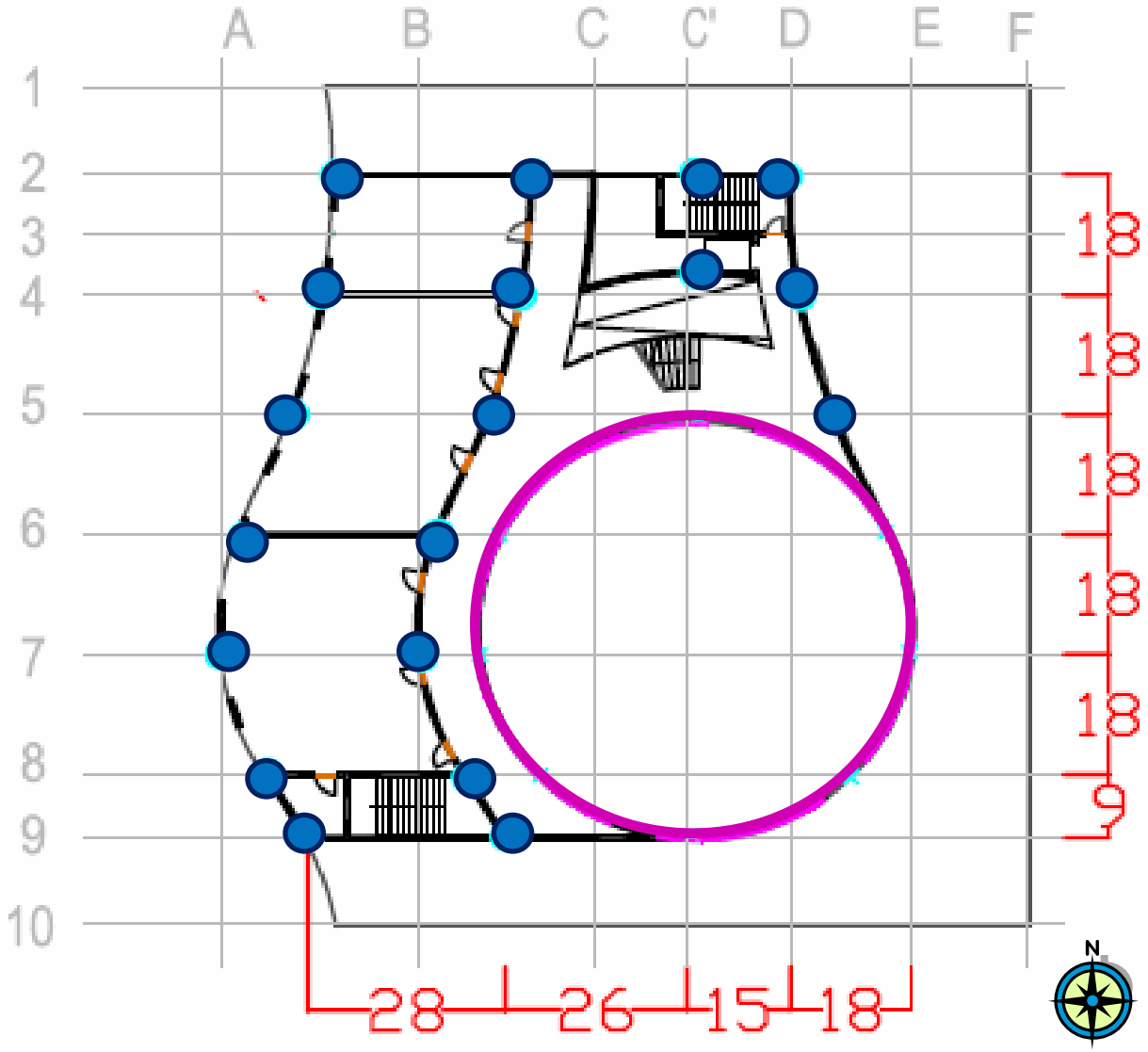




COLUMN LAYOUT



FIRST FLOOR

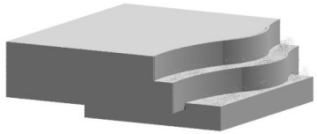


Columns

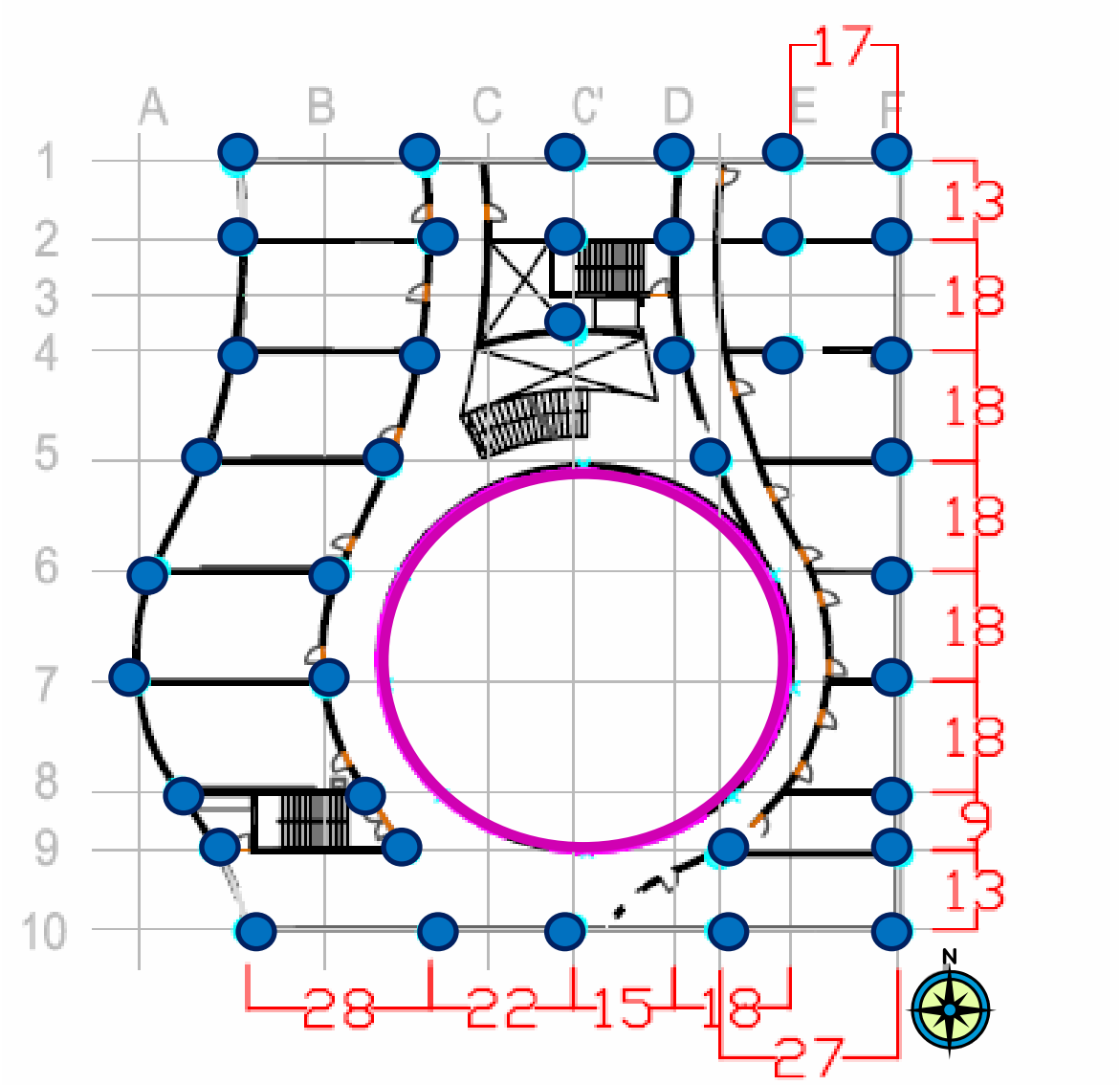
Shear Core

WAVE

COLUMN LAYOUT



SECOND FLOOR

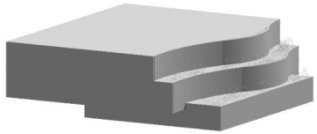


Columns

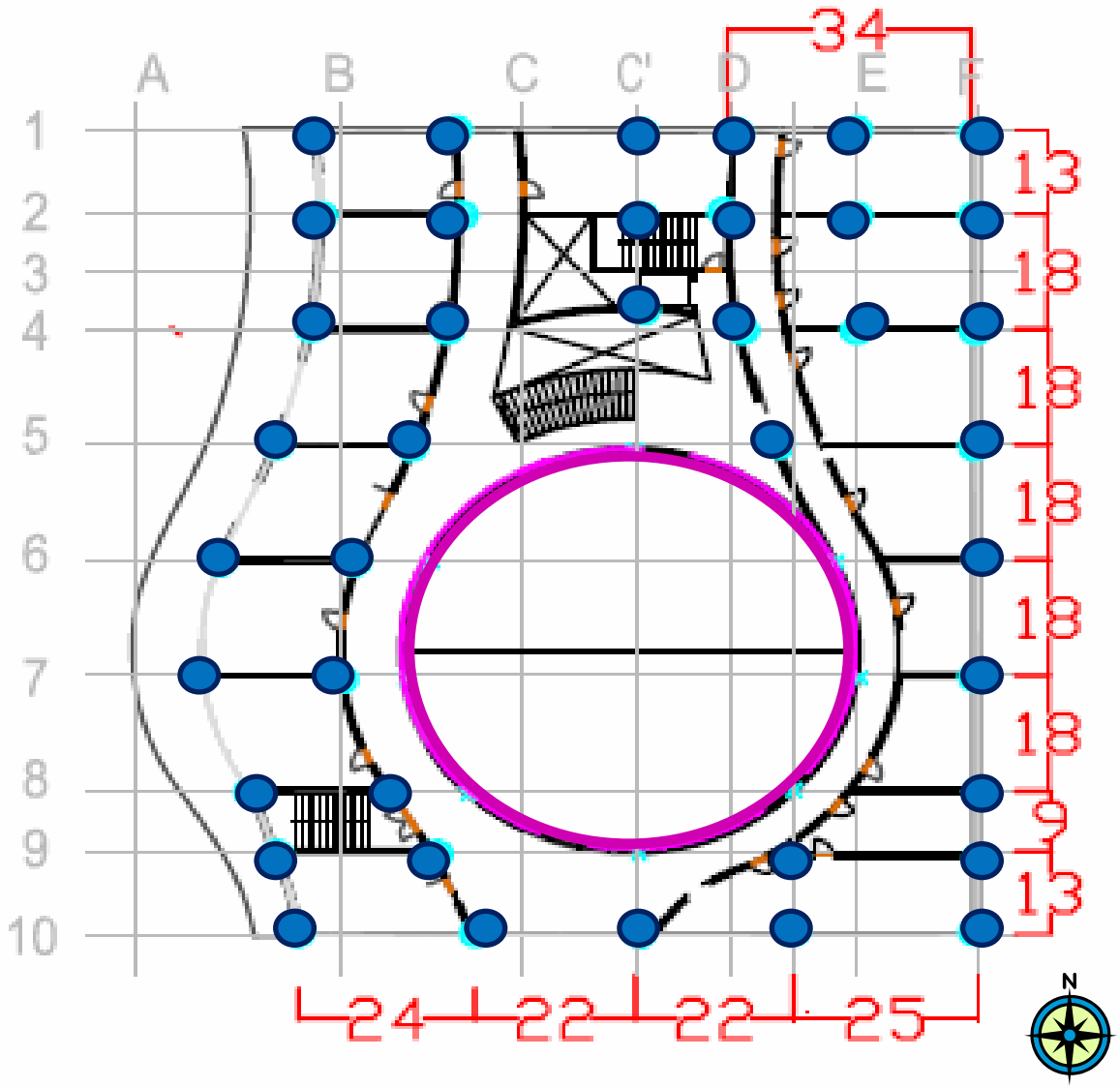
Shear Core

WAVE

COLUMN LAYOUT



THIRD FLOOR

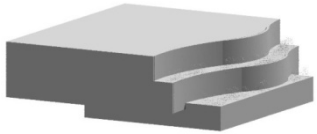


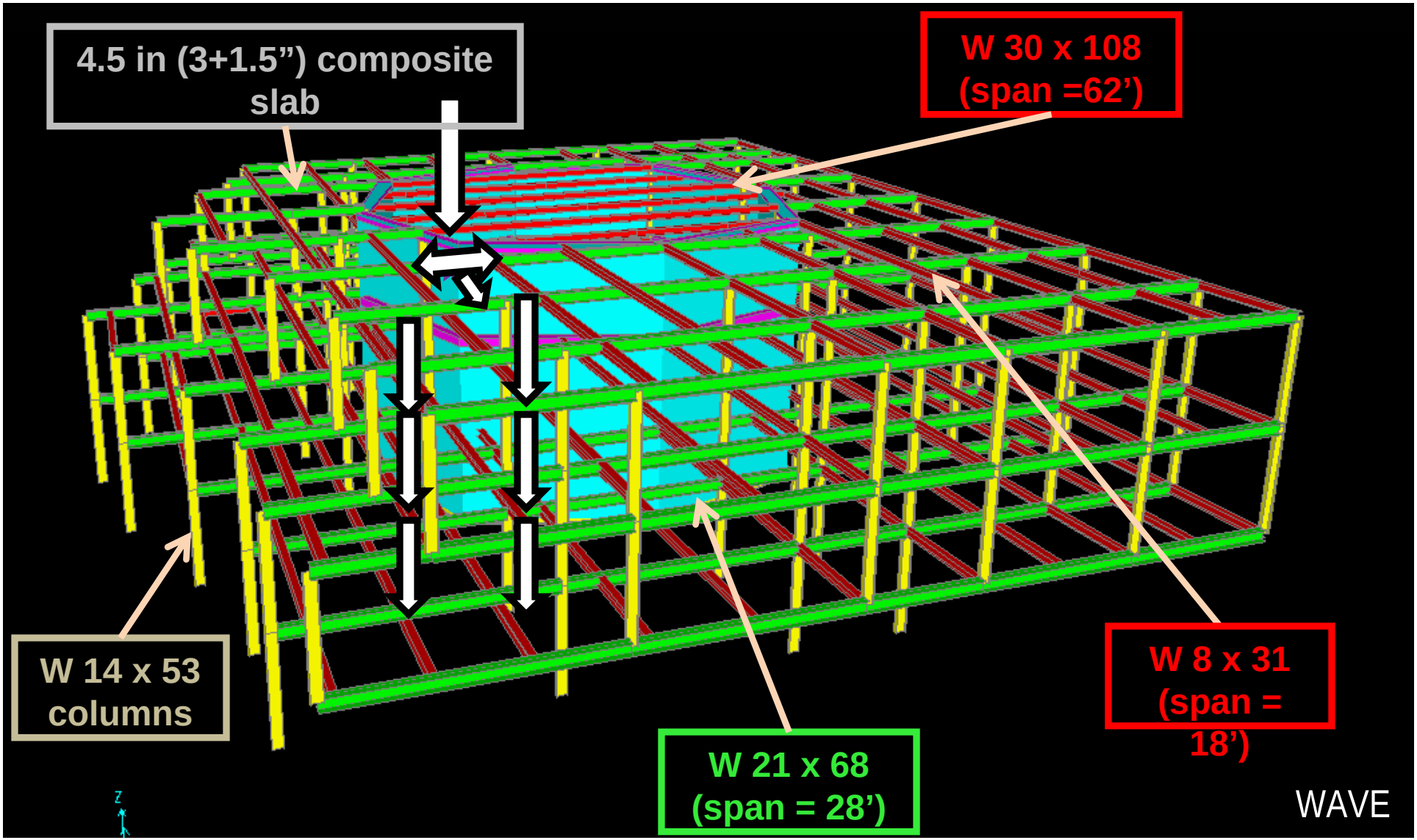
Columns

Shear Core

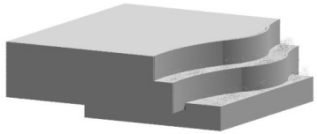
WAVE

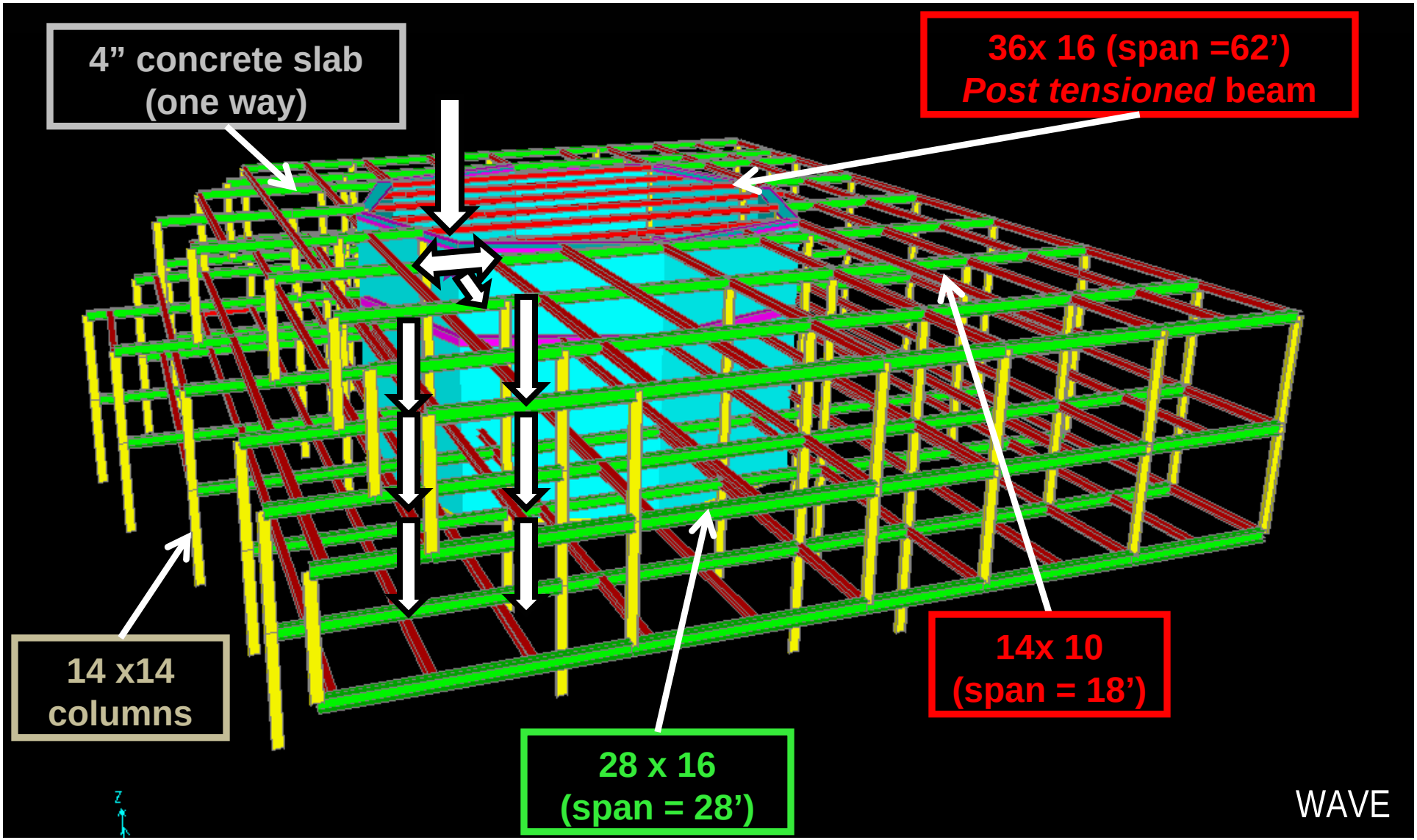
TYPICAL MEMBERS - STEEL



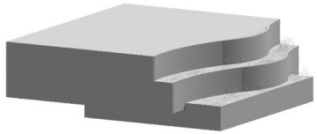


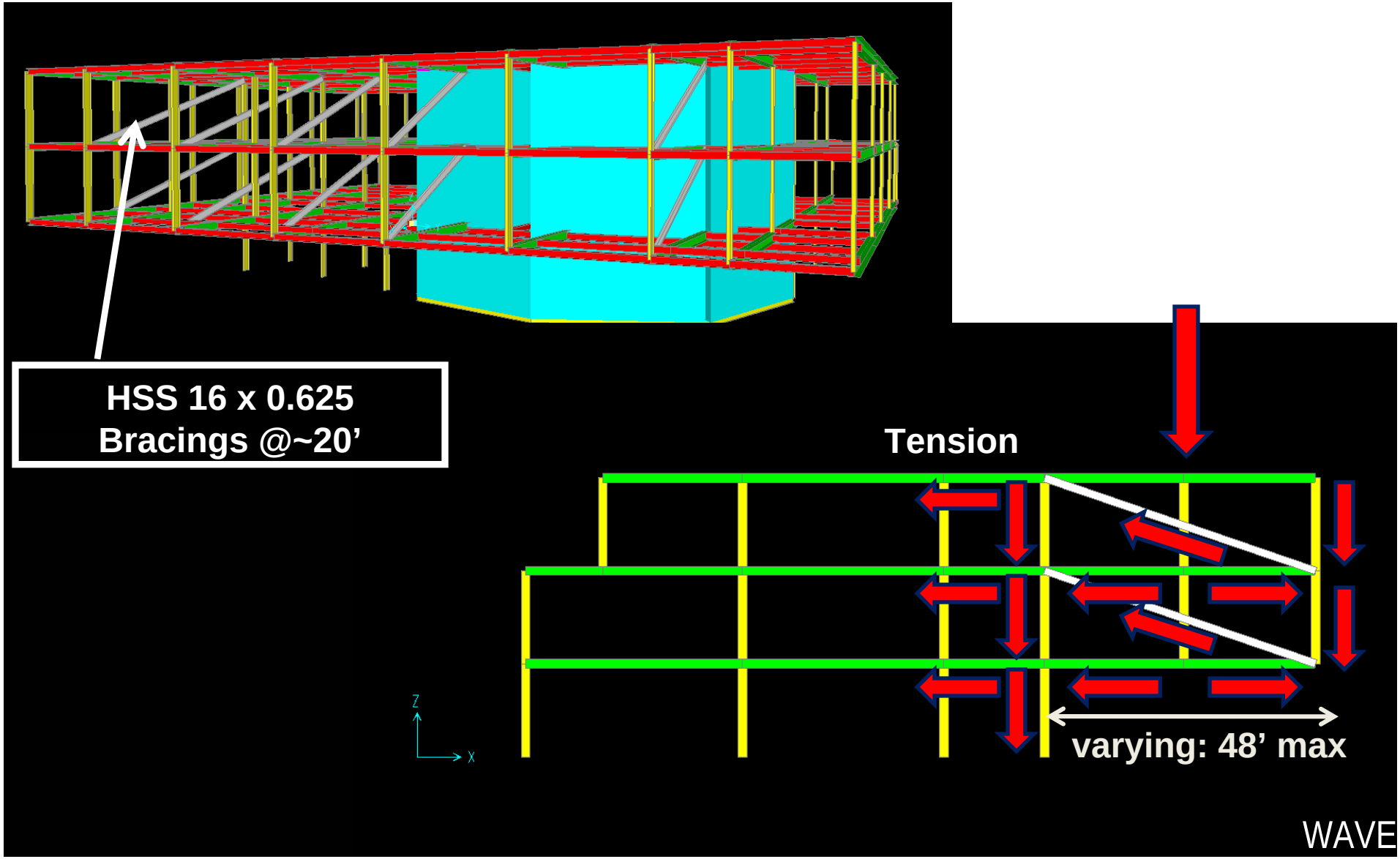
TYPICAL MEMBERS - CONCRETE



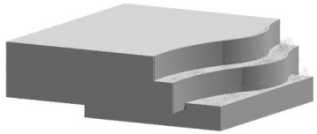


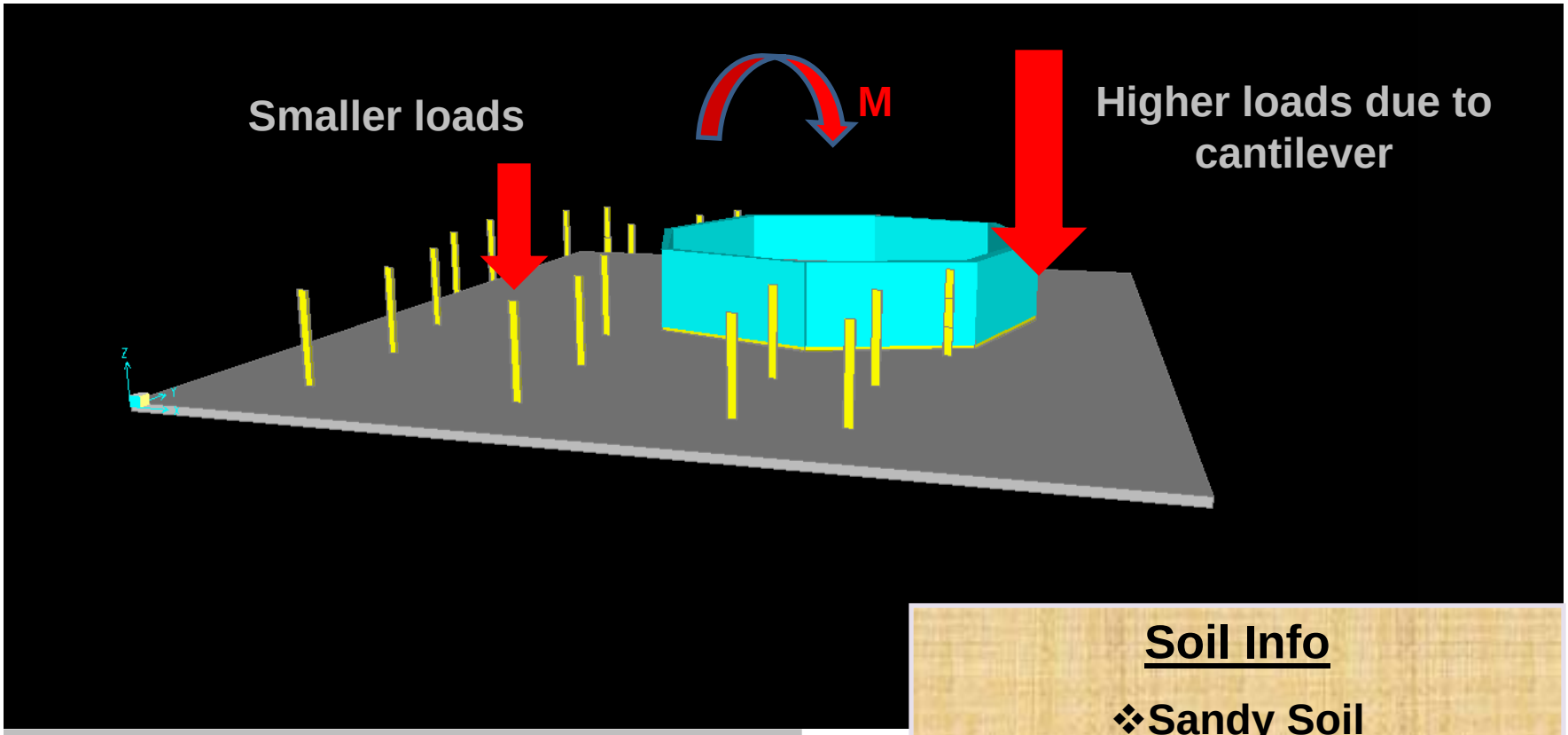
SOLUTION TO CHALLENGES - STEEL





FOUNDATION





Deep foundation is likely to be used

Soil Info

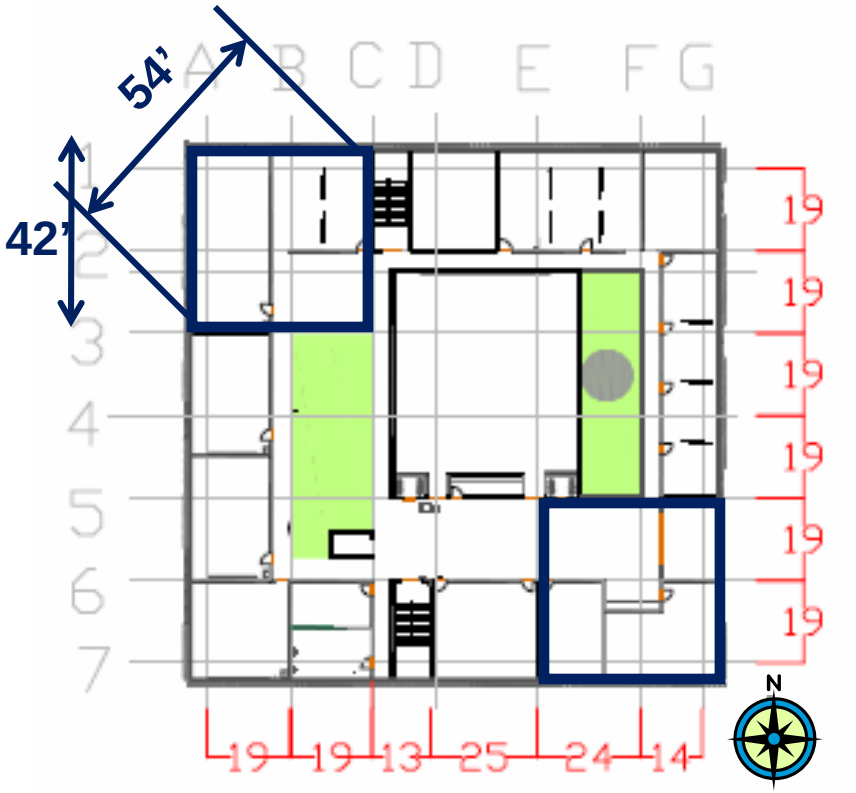
- ❖Sandy Soil
- ❖Bearing pressure: 5 ksf
- ❖Water depth: 15 ft
- ❖No liquefaction

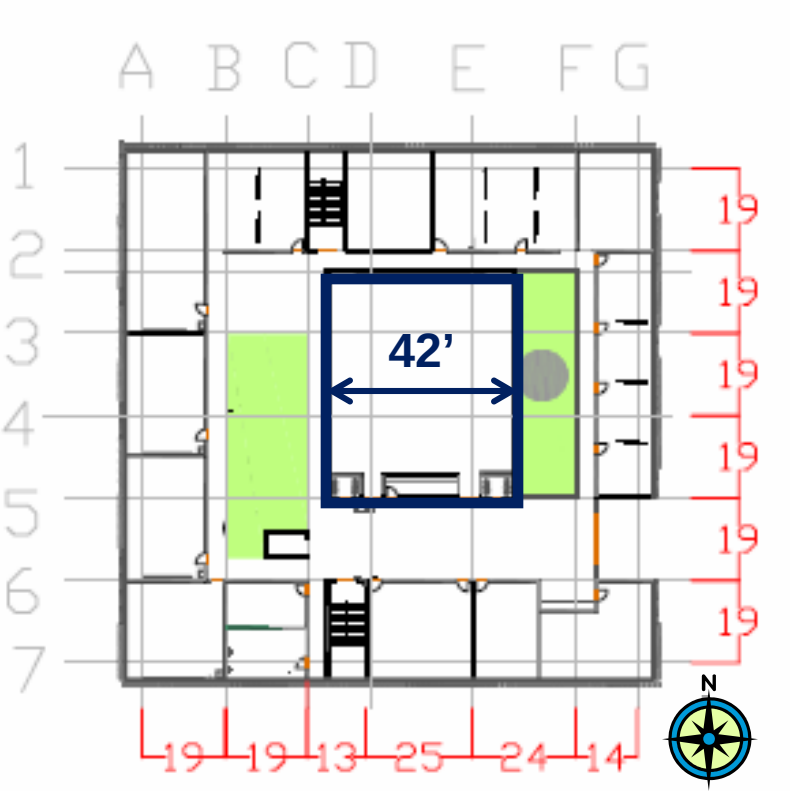
ARCHITECTURAL CONCEPT 2

NATURE

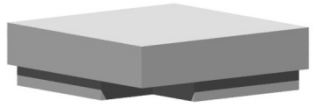
EVALUATION

- Challenges
  - ★ Two story cantilever, 42 ft long
  - ★ Inside openings interrupting EQ load path
- Advantages
  - ★ The more rectangular form of the building
  - ★ Allowance for the concrete core around the auditorium

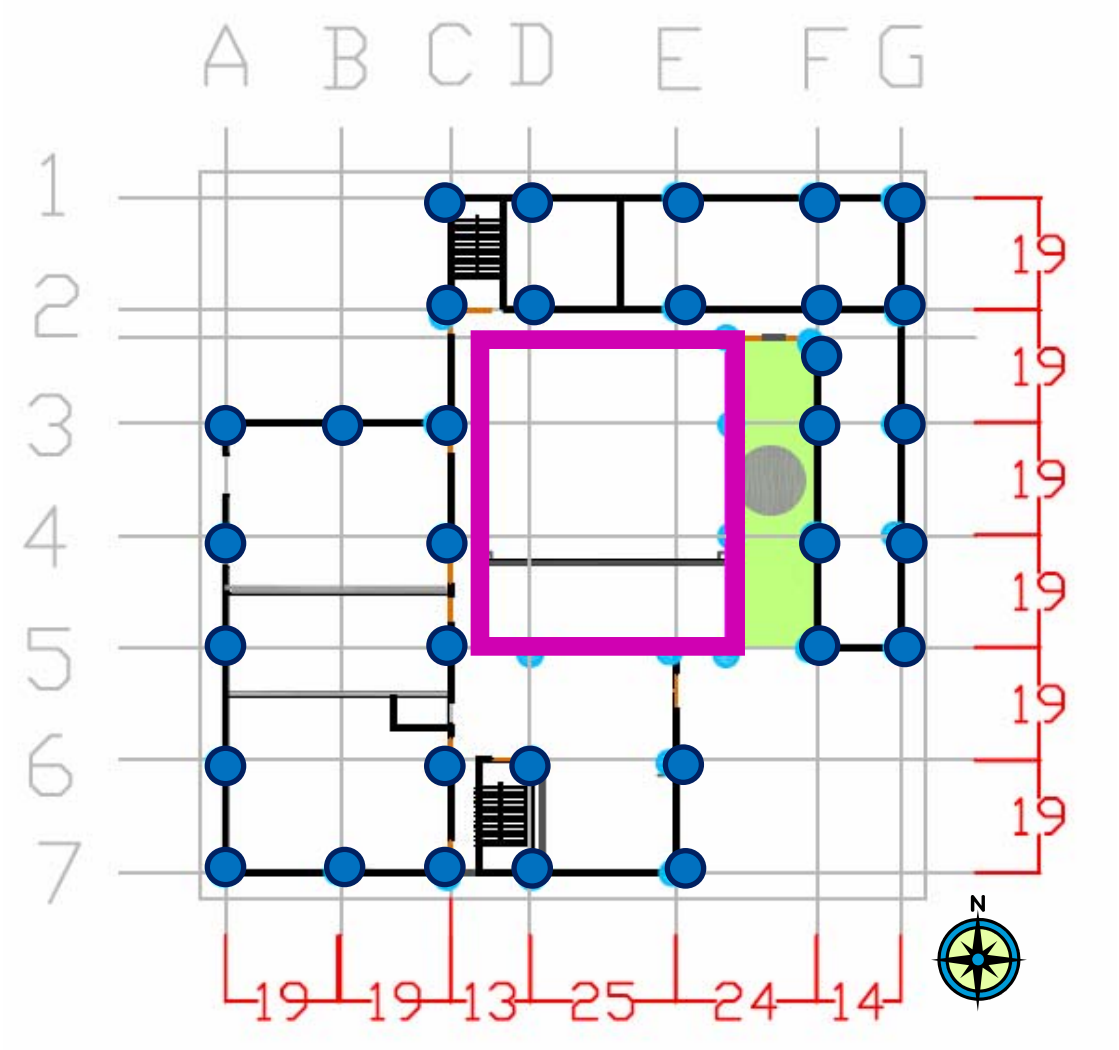




COLUMN LAYOUT



FIRST FLOOR

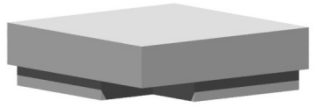


Columns

Shear Core

NATURE

COLUMN LAYOUT



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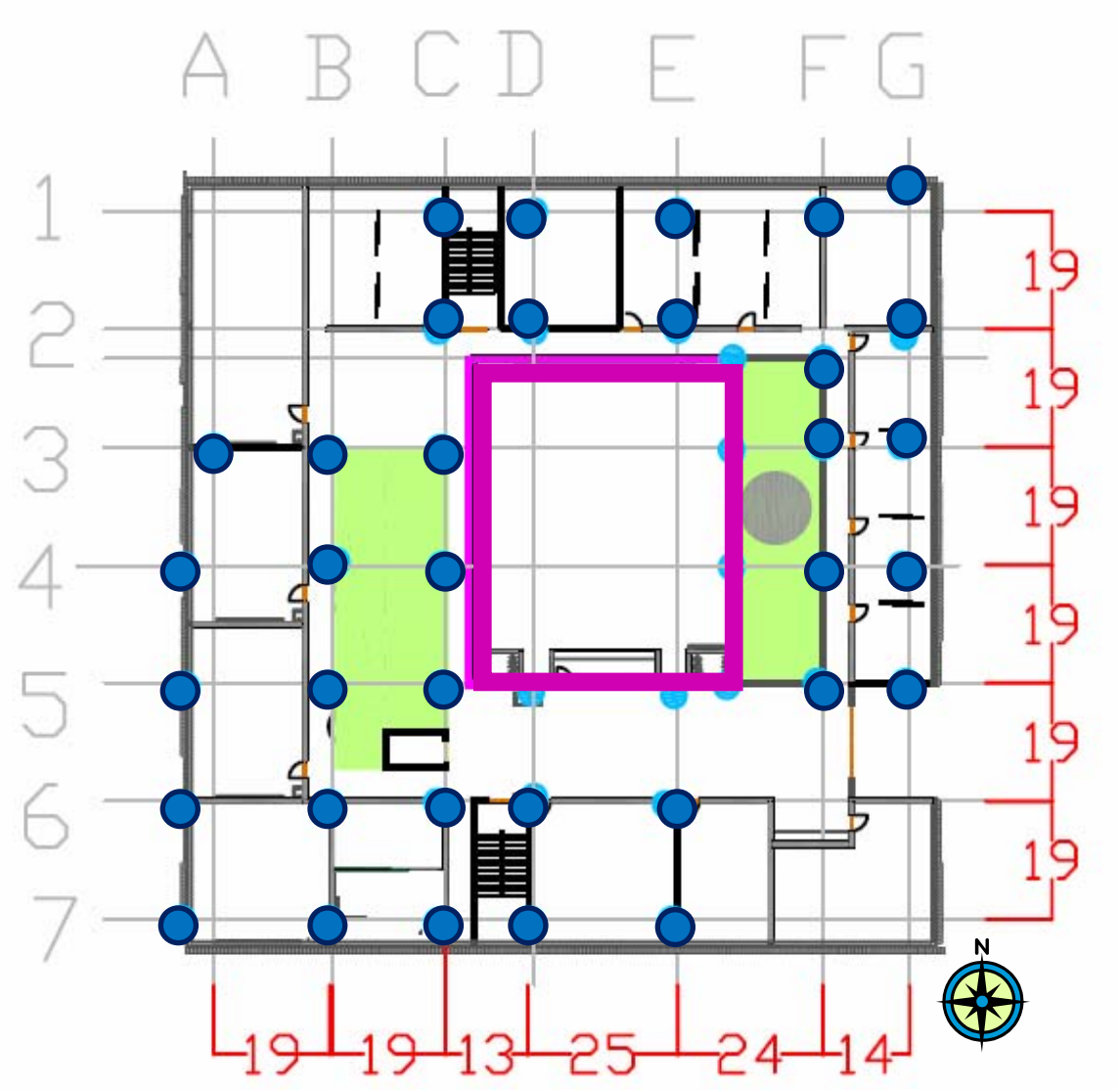
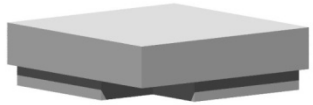


Columns

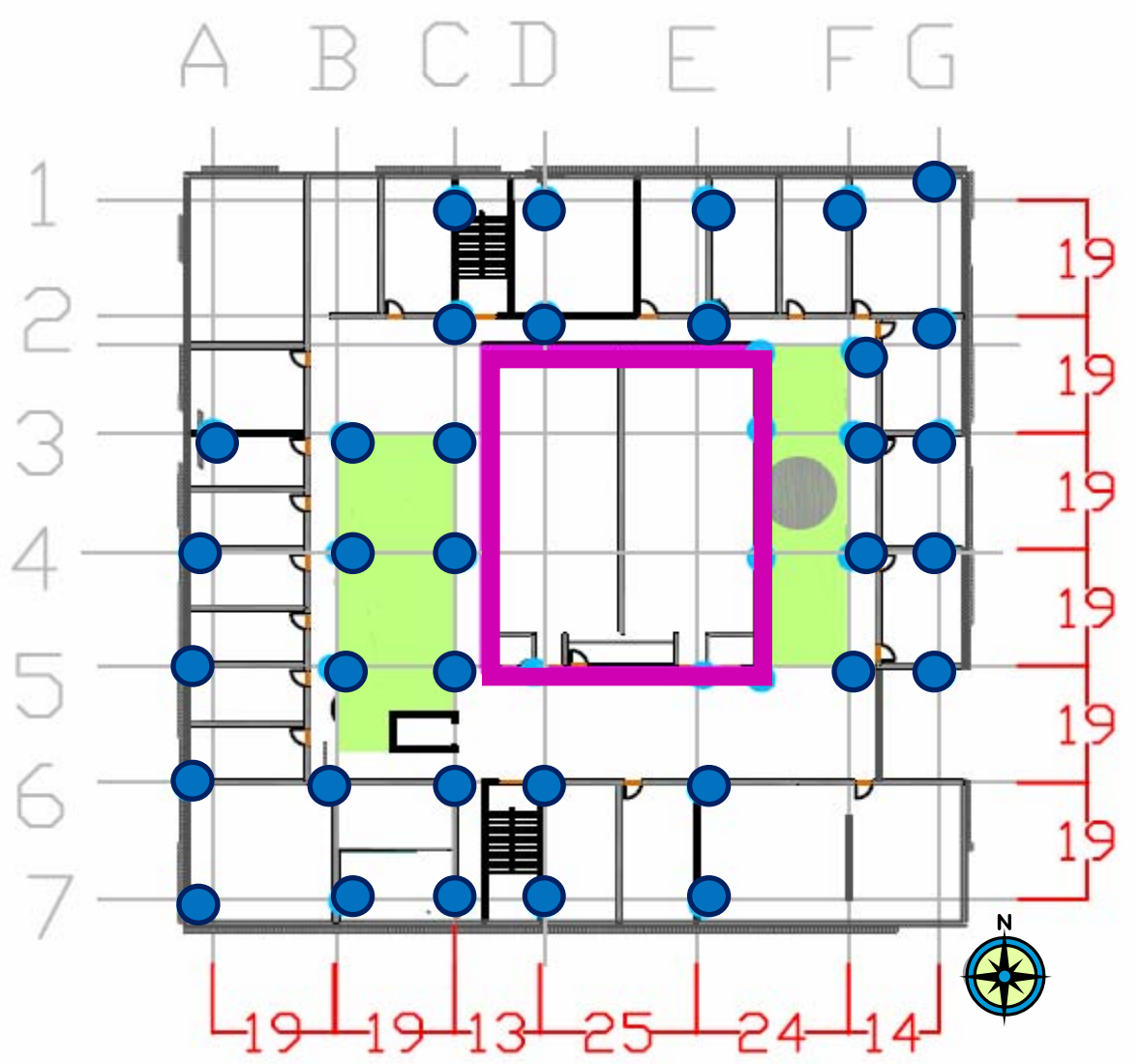
Shear Core

NATURE

COLUMN LAYOUT



THIRD FLOOR

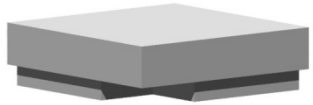


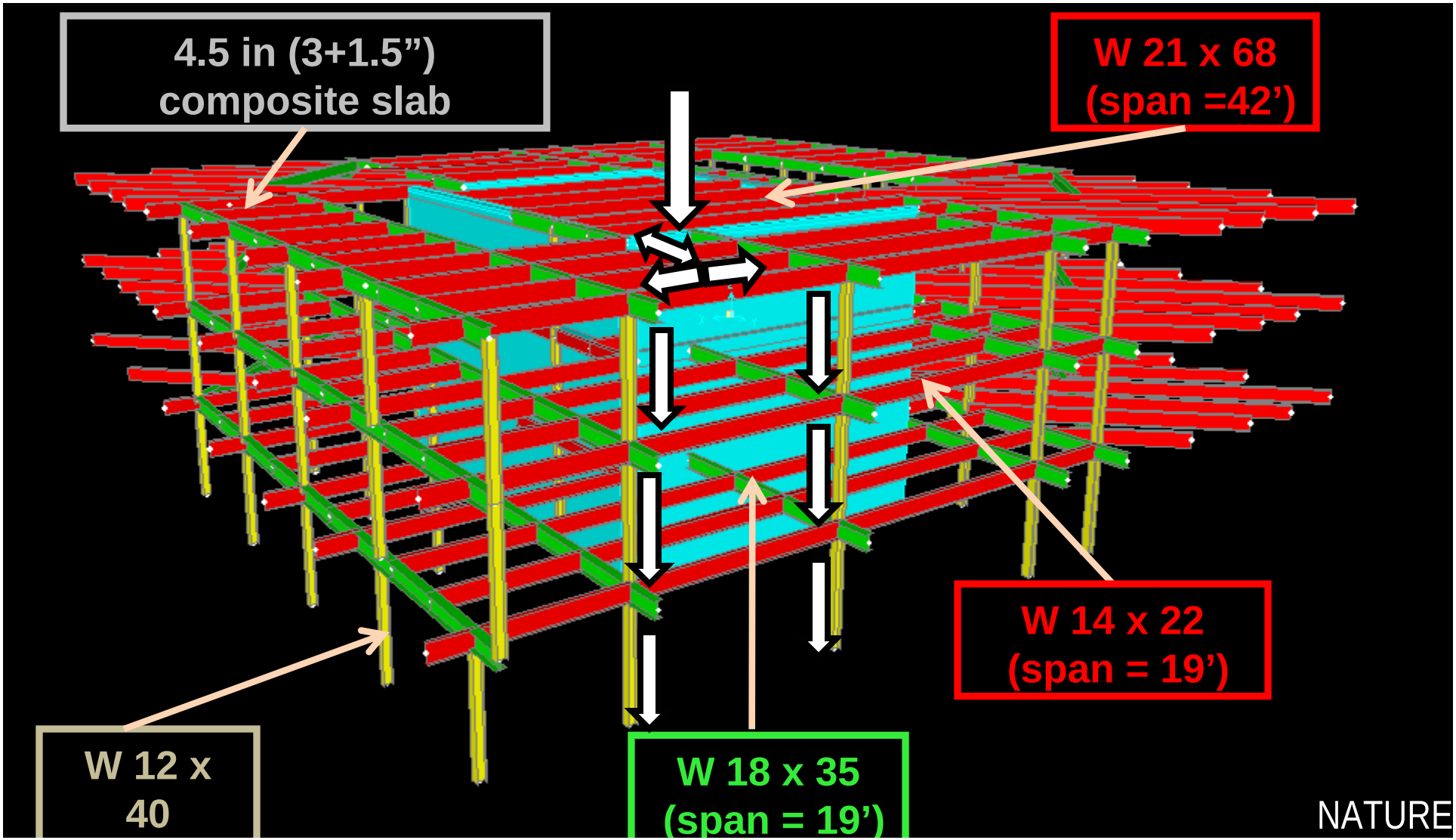
Columns

Shear Core

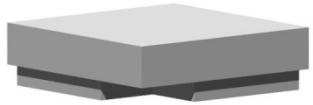
NATURE

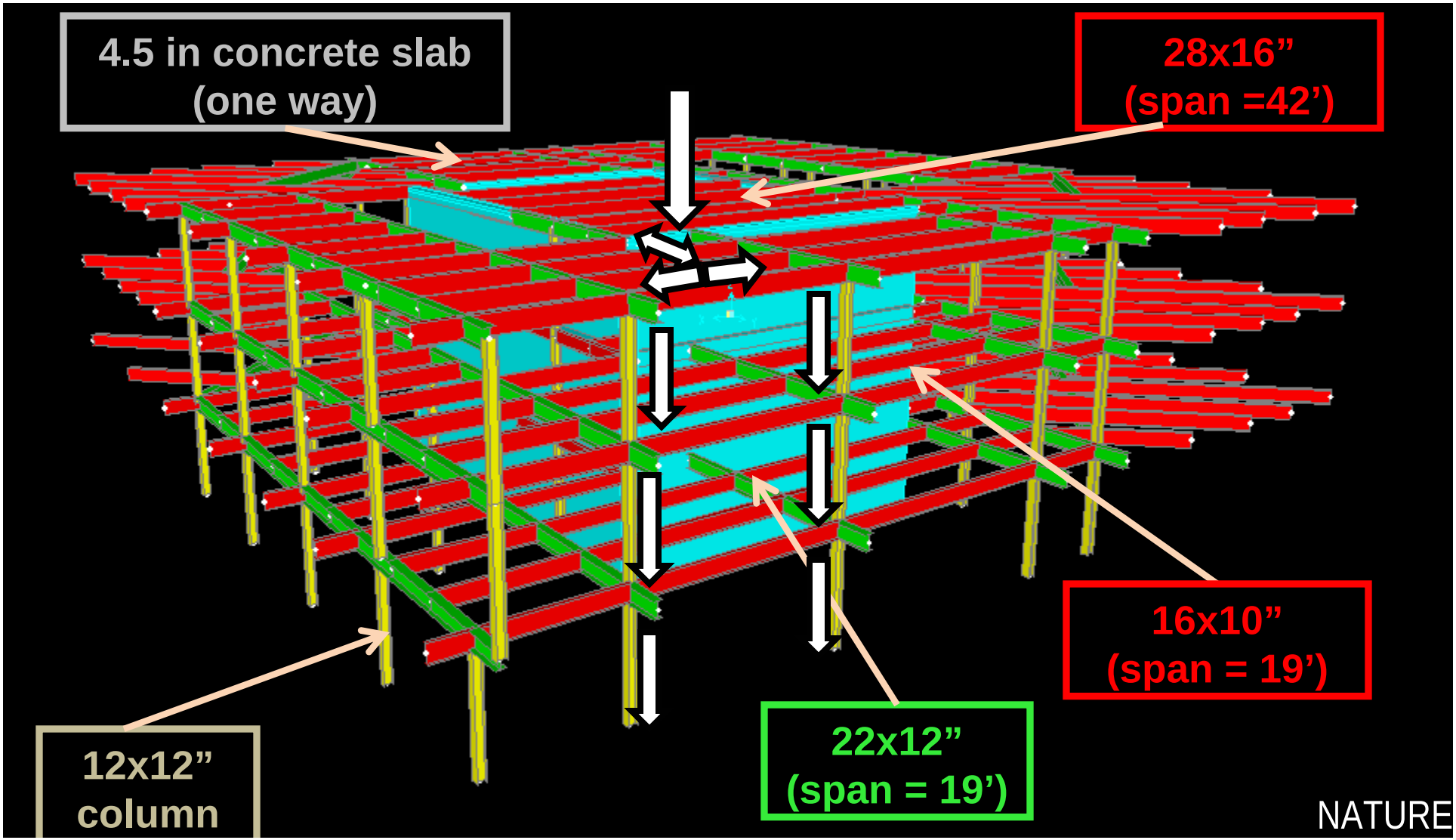
TYPICAL MEMBERS - STEEL



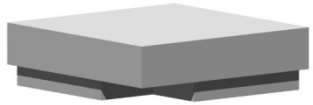


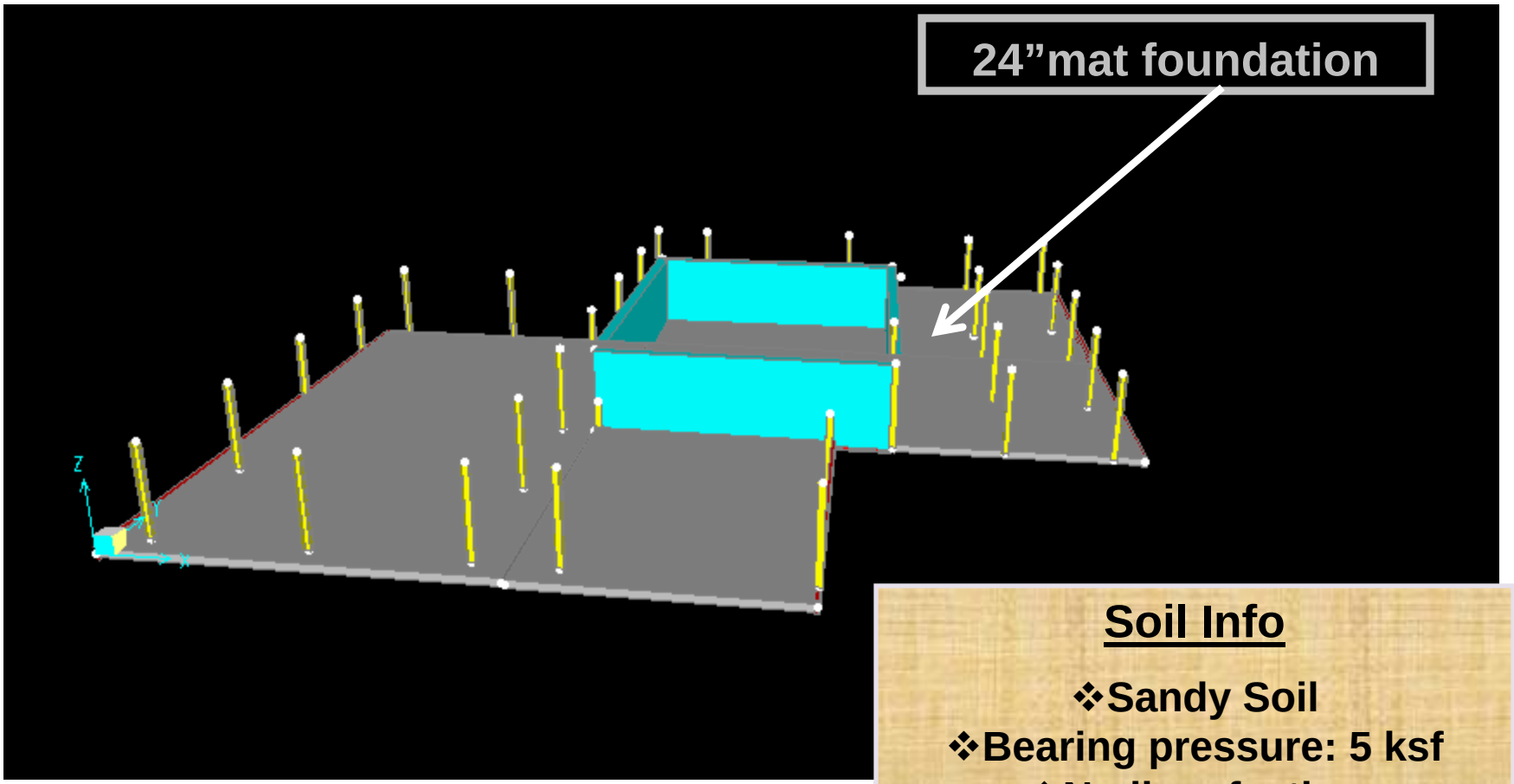
TYPICAL MEMBERS - CONCRETE





FOUNDATION





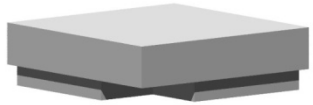
Soil Info

- ❖Sandy Soil
- ❖Bearing pressure: 5 ksf
- ❖No liquefaction
- ❖Water depth: 15 ft

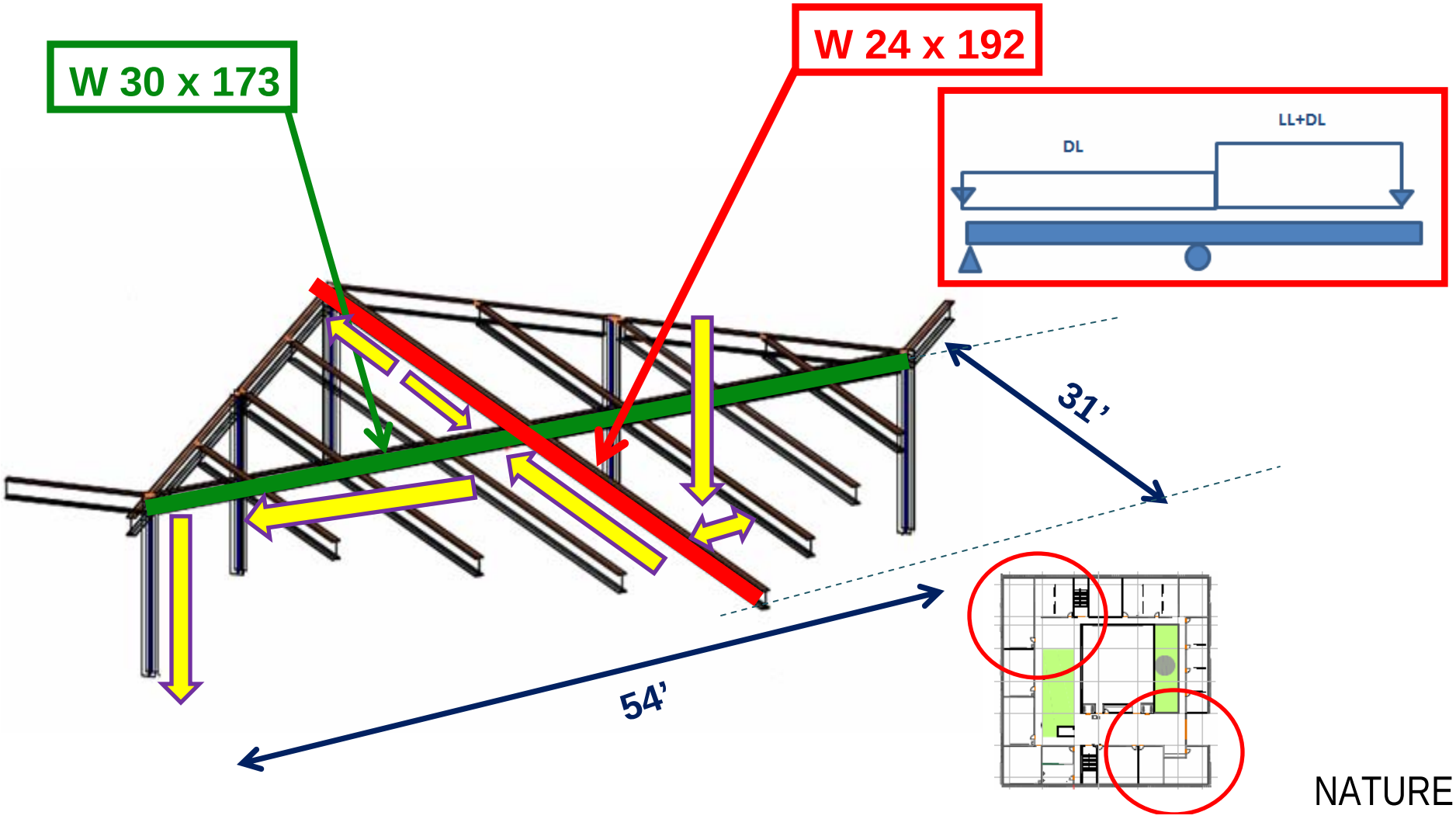
q_{max} = 1.1 ksf <<5 ksf

NATURE

SOLUTION TO CHALLENGES - STEEL

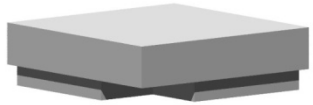


Diagonal grid…

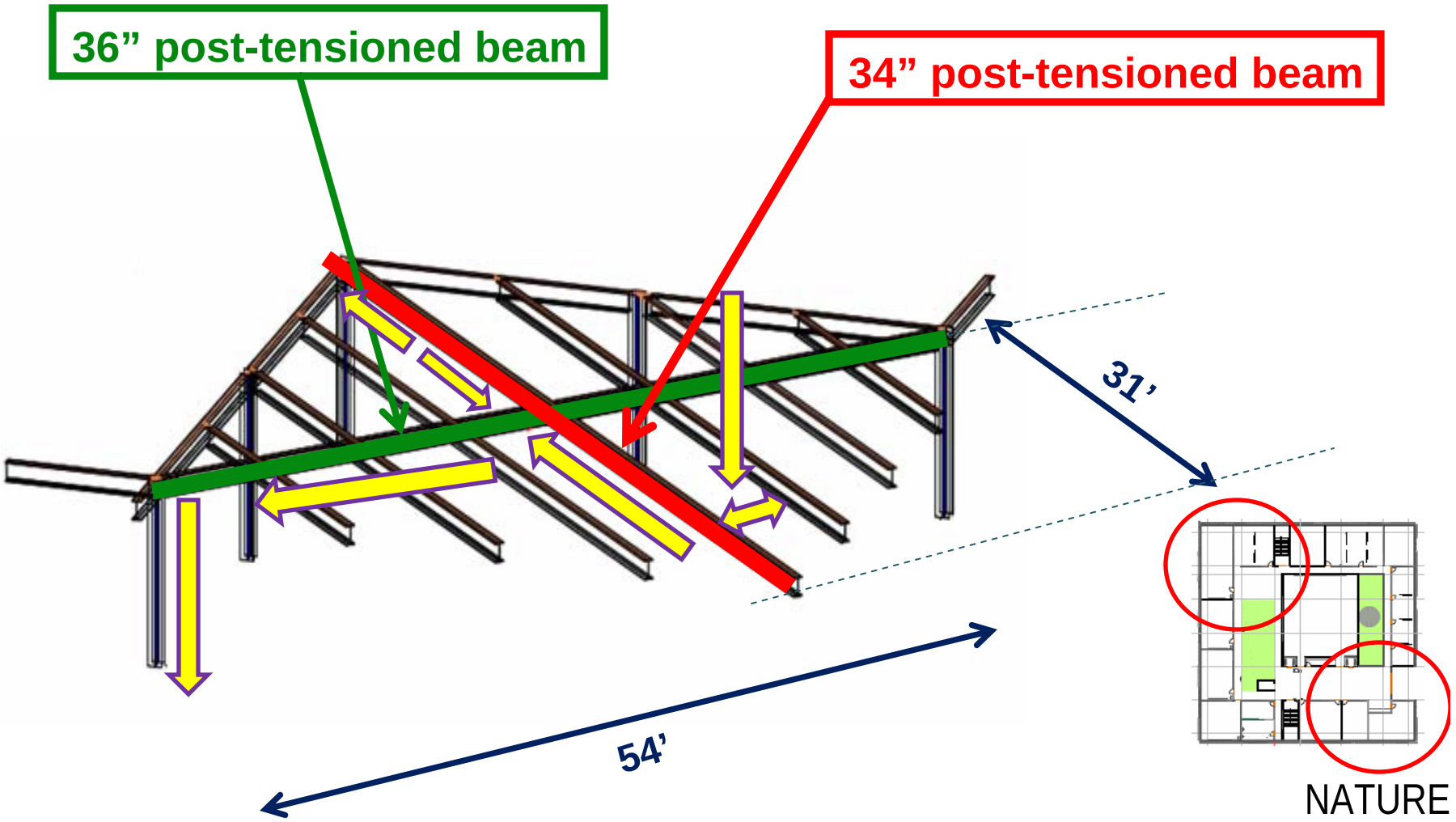


NATURE

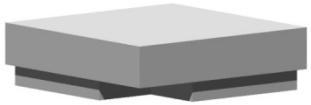
SOLUTION TO CHALLENGES - CONCRETE

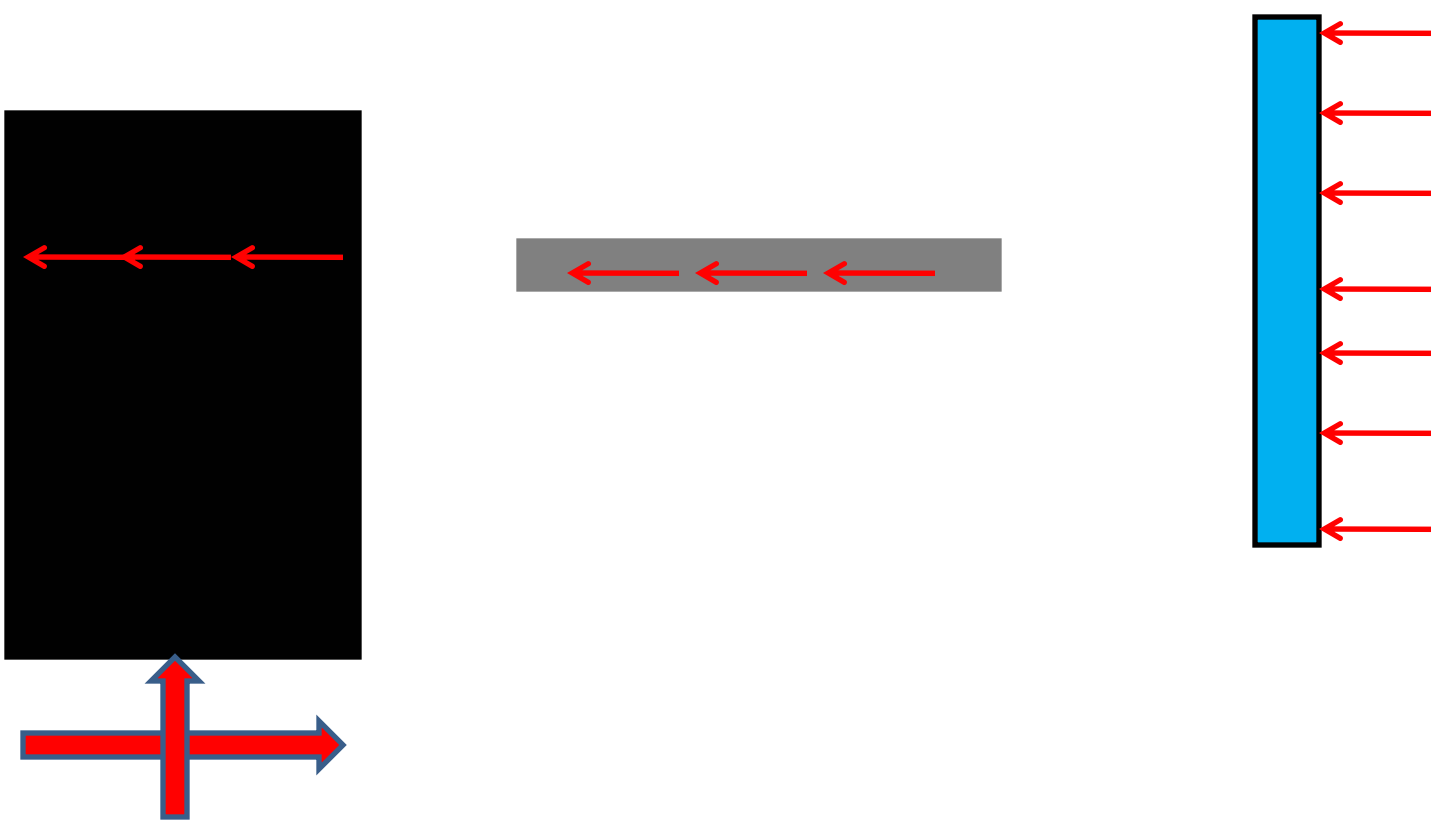


Diagonal grid…



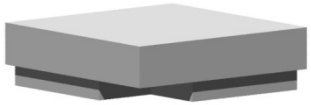
LATERAL LOAD PATH (WIND)

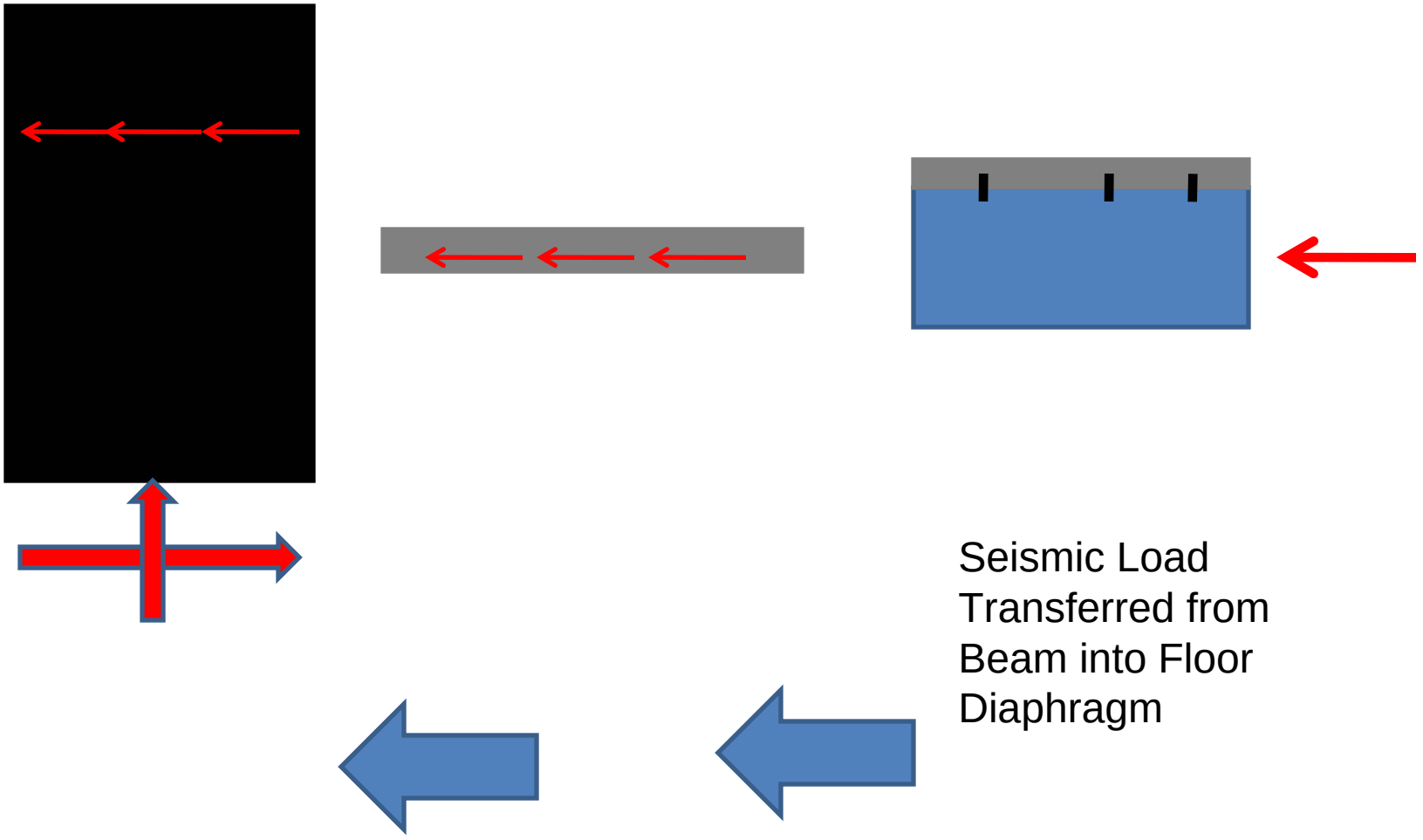




NATURE

LATERAL LOAD PATH (SEISMIC)

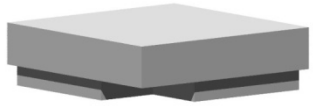


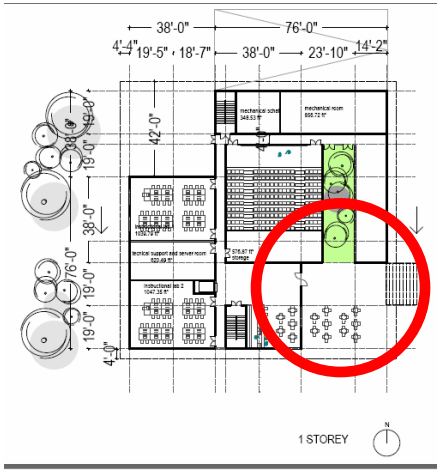


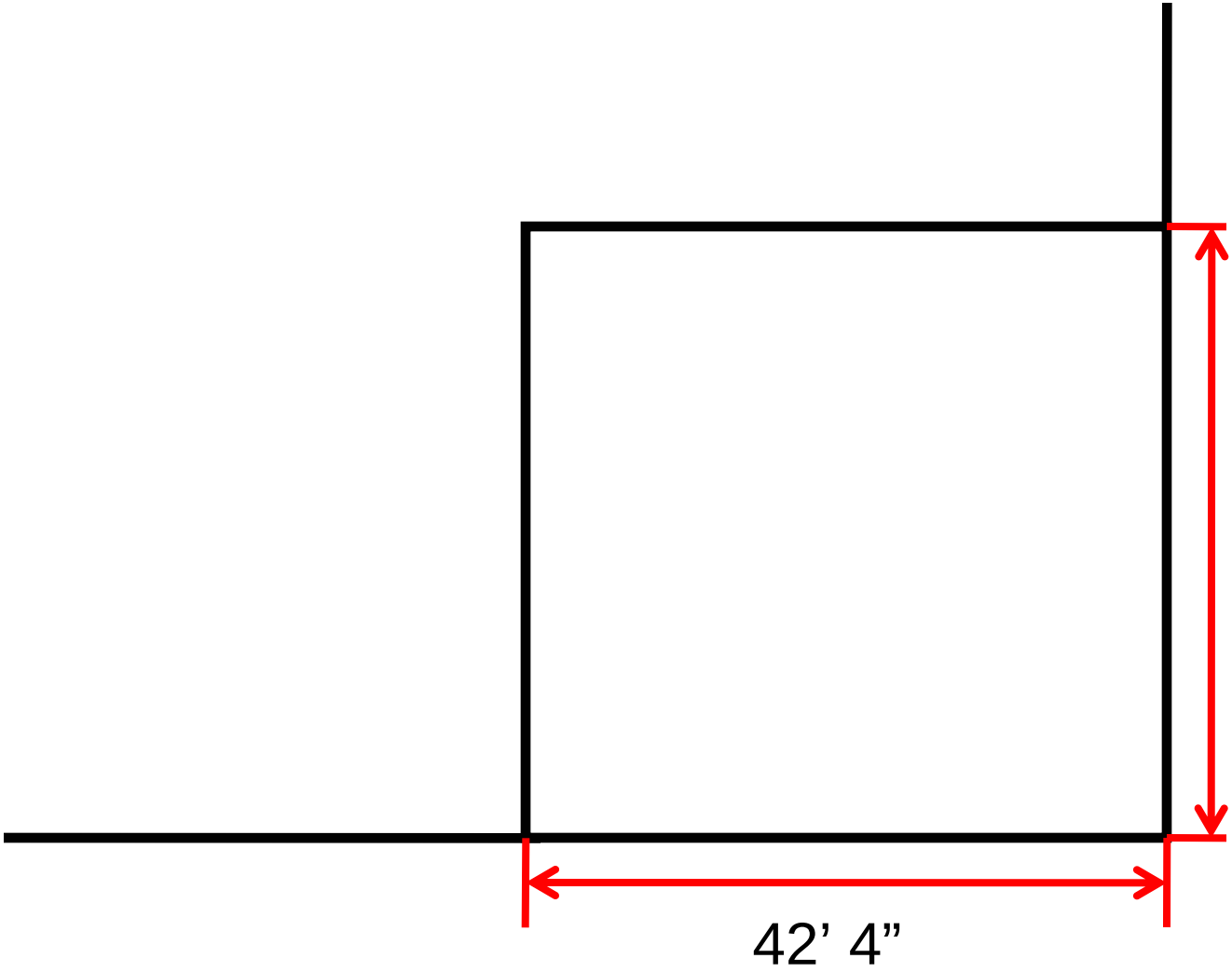
Seismic Load
Transferred from
Beam into Floor
Diaphragm

NATURE

CANTILEVER

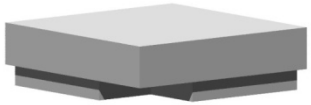


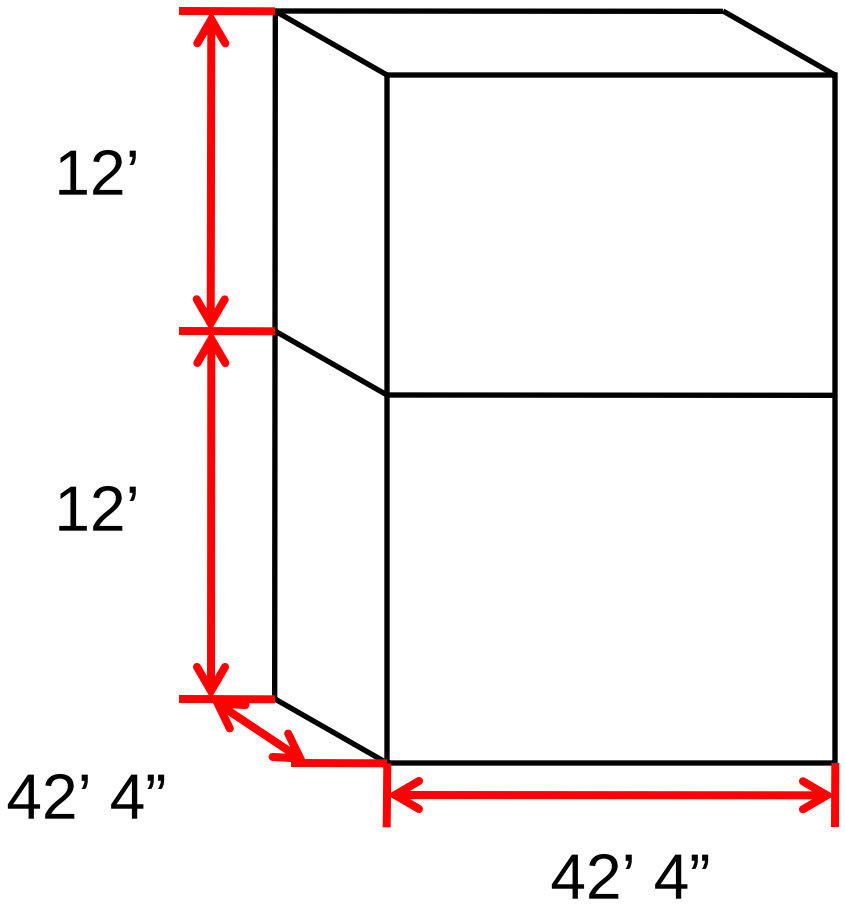




NATURE

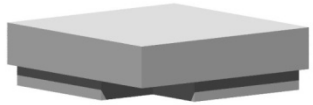
DESIGN OF CANTILEVER

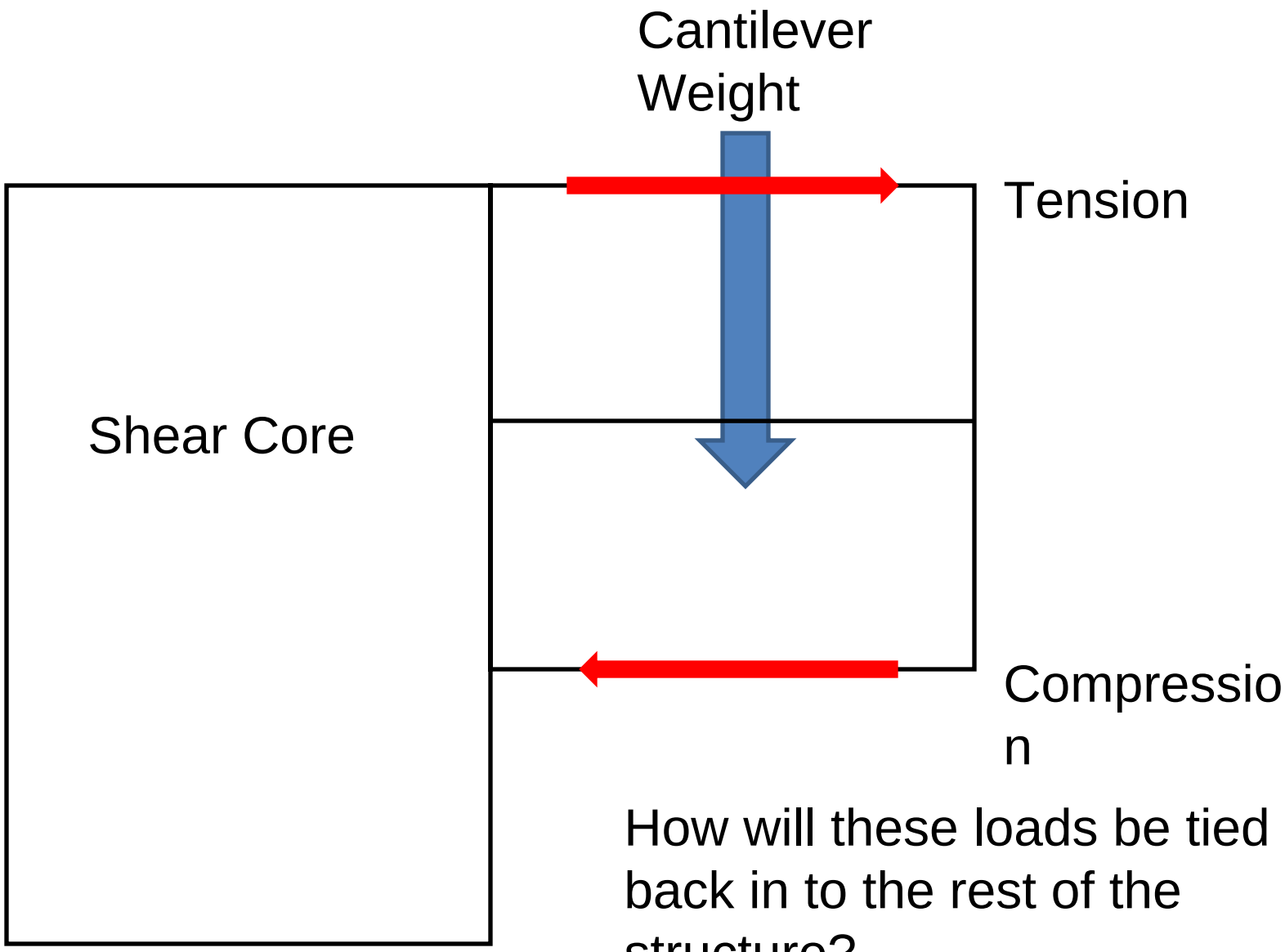




NATURE

LOAD PATHS IN TOP & BOTTOM CHORDS

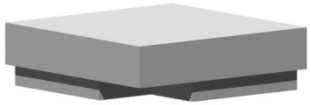


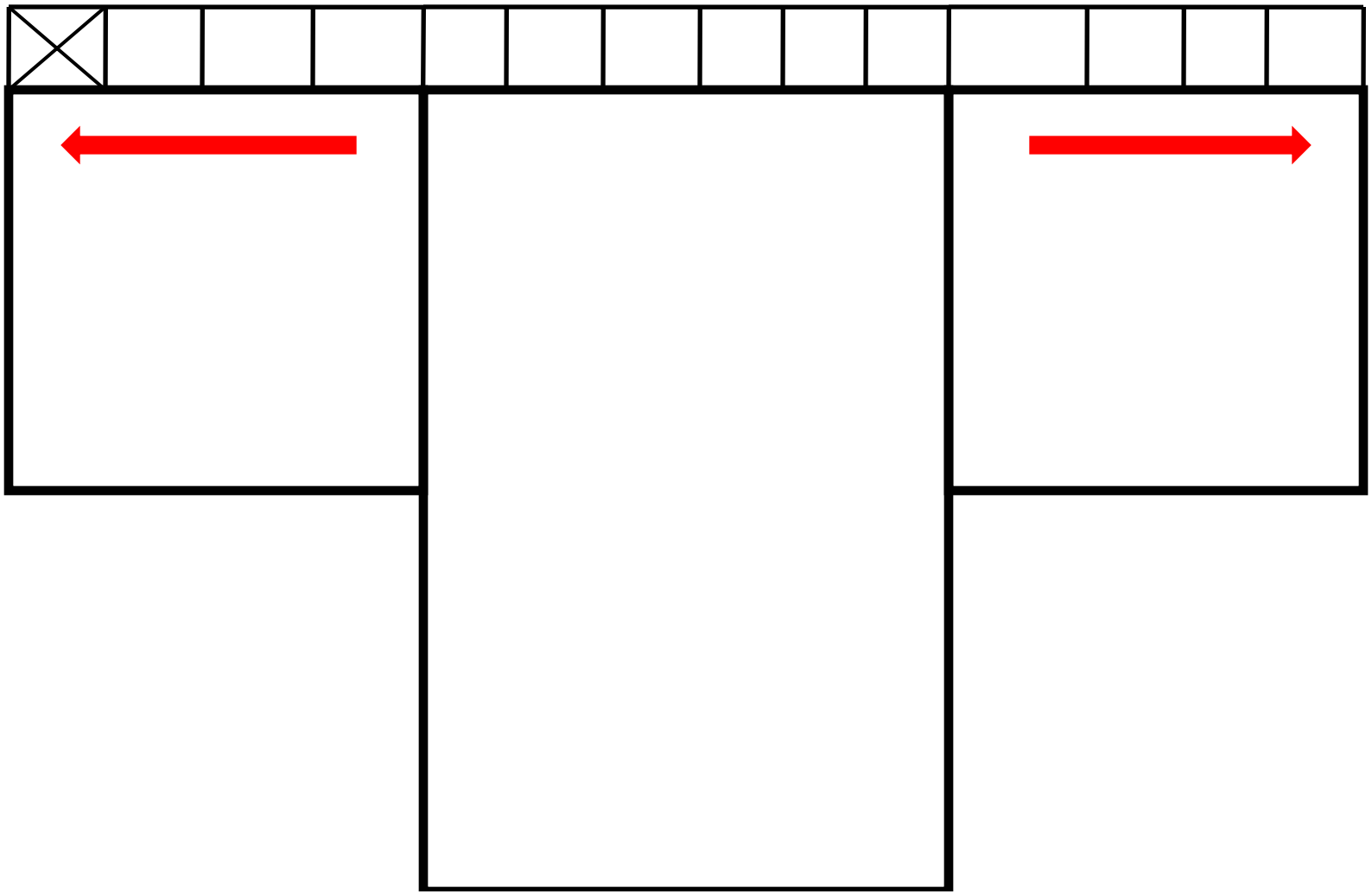


How will these loads be tied back in to the rest of the structure?

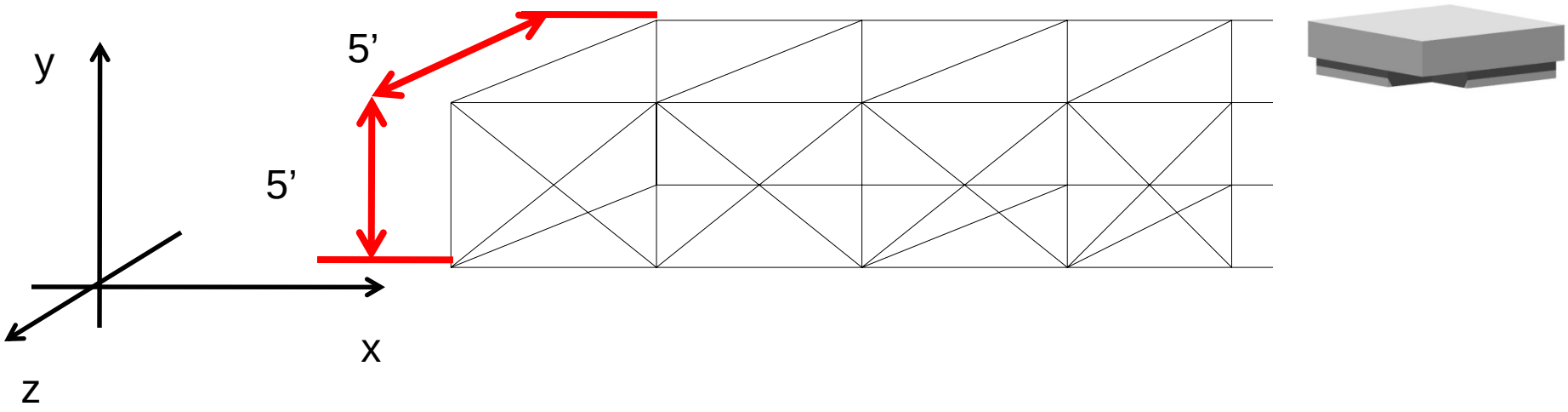
NATURE

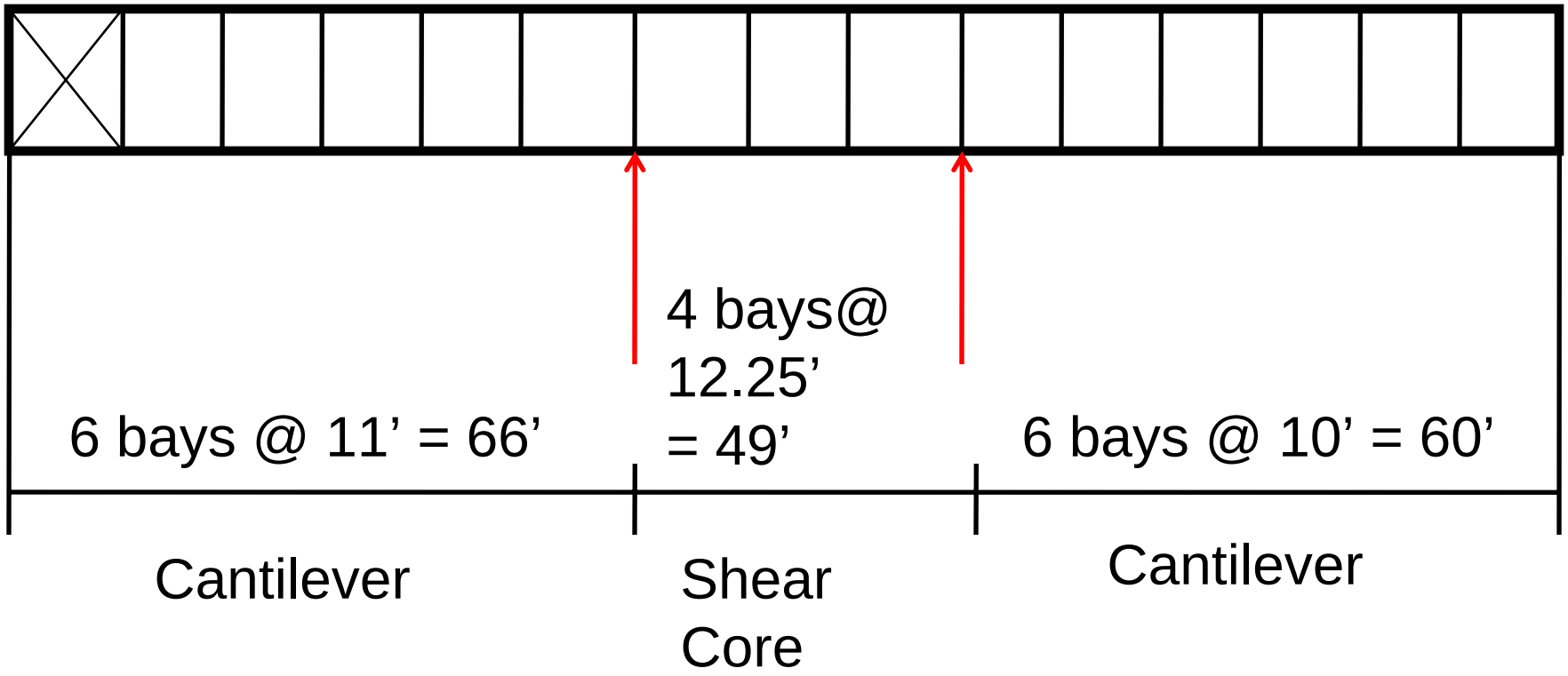
ROOF TRUSS FOR TENSION LOADS





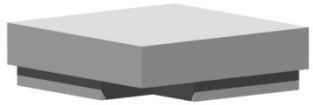
NATURE

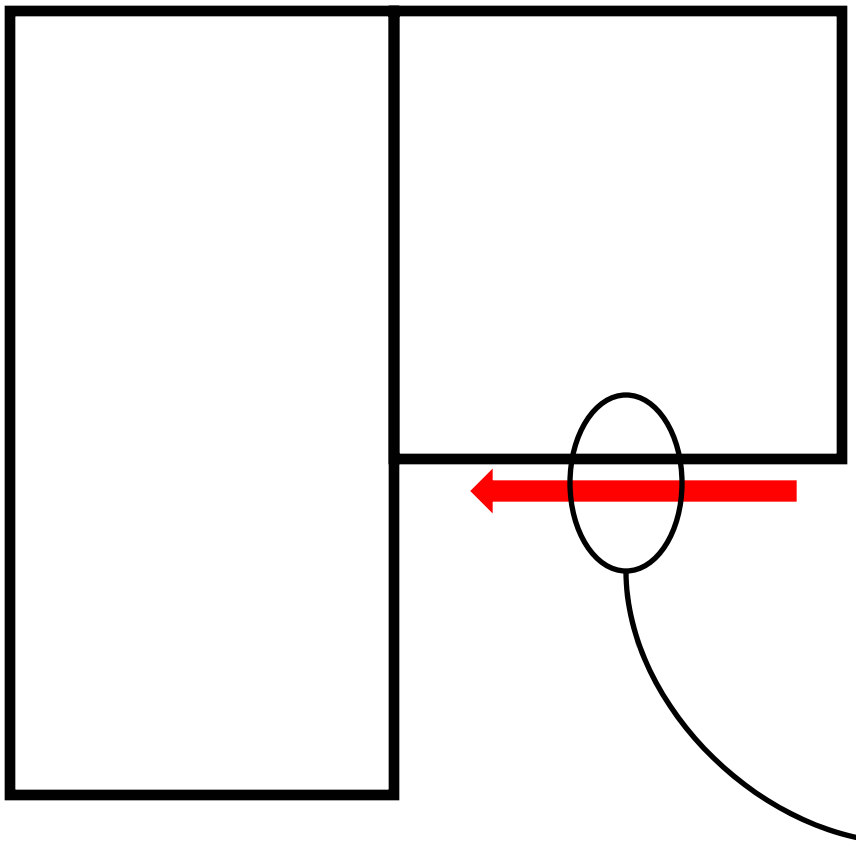

y
x
z
5’
5’


4 bays@
12.25’
= 49’
6 bays @ 11’ = 66’
6 bays @ 10’ = 60’
Cantilever
Shear
Core
Cantilever

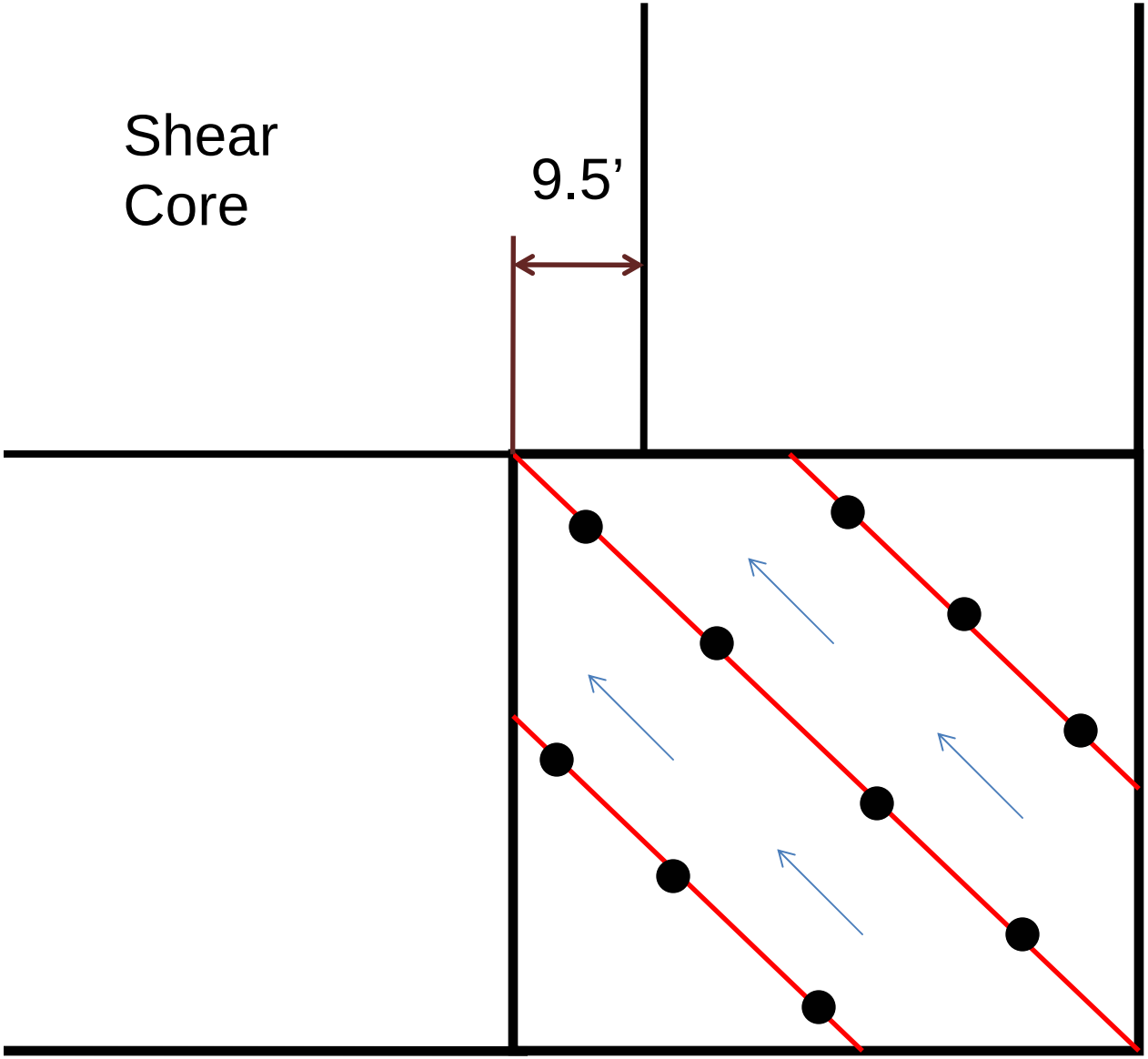
NATURE

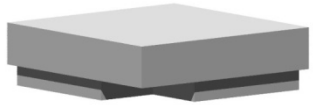
COMPRESSION LOADS

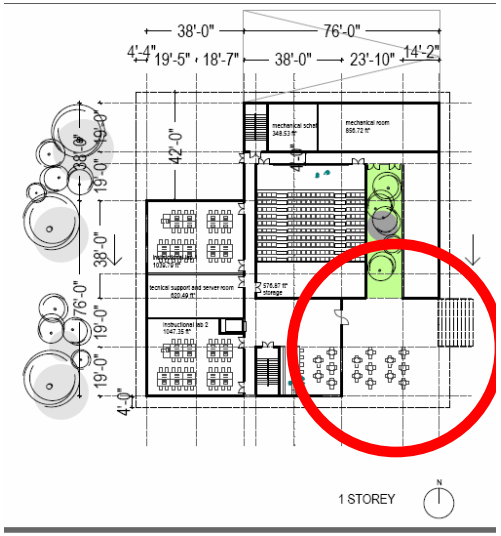




Plan view on next slide…


Shear
Core
9.5’



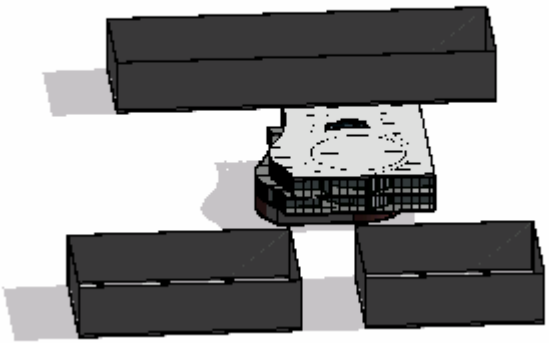

38'-0"
76'-0"
4'-4"
19'-5"
18'-7"
38'-0"
23'-10"
14'-2"
42'-0"
38'-0"
76'-0"
19'-0"
4'-0"
1 STOREY

NATURE

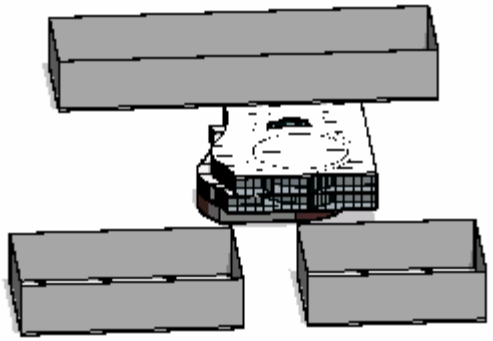
SUN PATH

CONCEPT 1 – SUMMER TIME

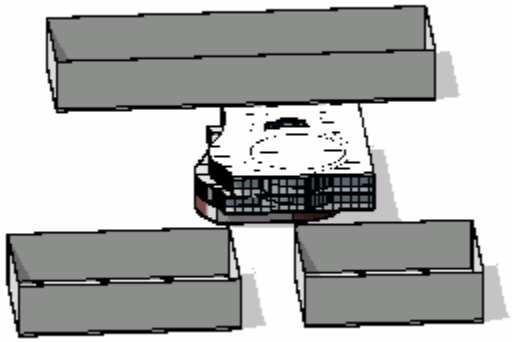
@ 09:00



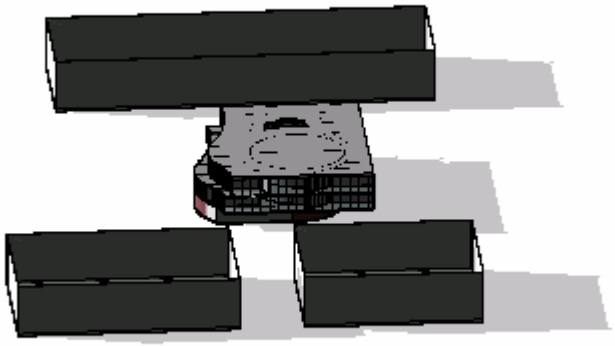
@ 12:30



@ 15:00



@ 18:00

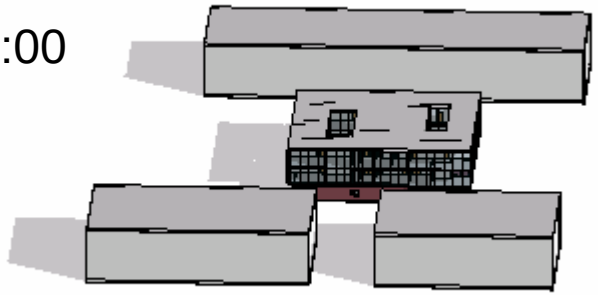


WAVE

SUN PATH

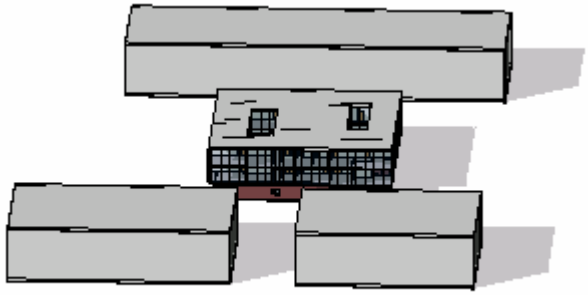
CONCEPT 1 – SUMMER TIME

@ 09:00

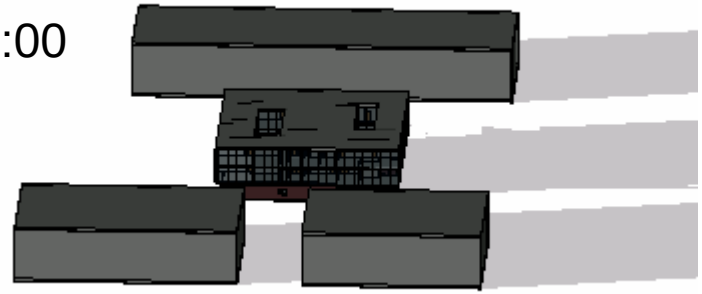


@ 12:30

@ 15:00



@ 18:00



NATURE

BUILDING ZONES

Zone 1: Auditorium, Big Classrooms

Zone 2: Stairways, Hallways, Café

Zone 3: Seminar Rooms, Small Classrooms

Zone 4: Student Offices

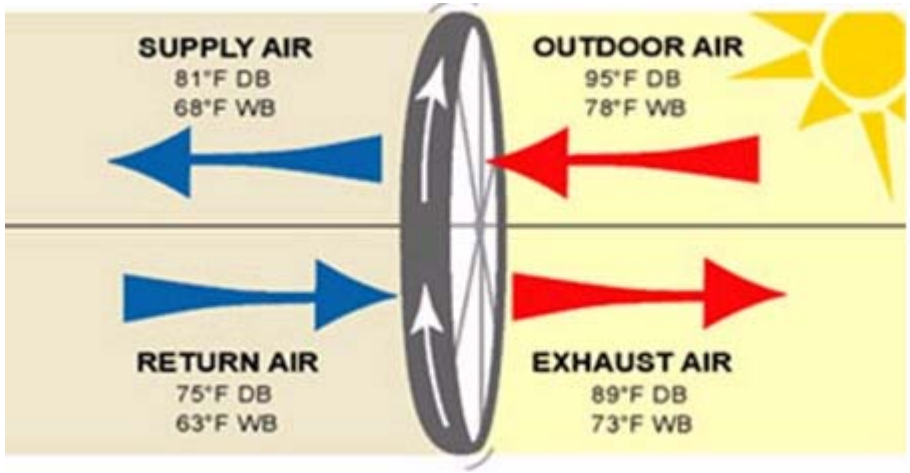
Zone 5: Faculty/Administrative Offices

Zone 6: Server Room

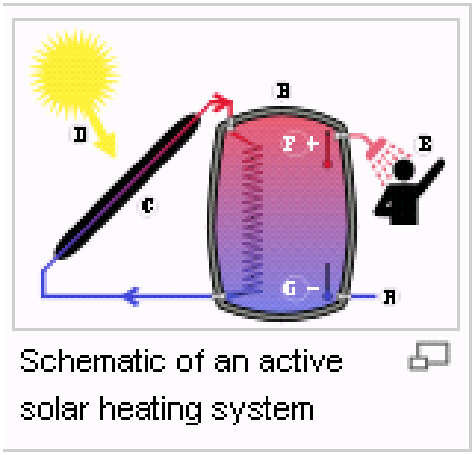
COOLING SYSTEMS

44F/4C chilled water from CHP plant

- Scenario 1:
  - Dew point cooling humidity control
- Scenario 2:
  - Thermal wheel humidity control



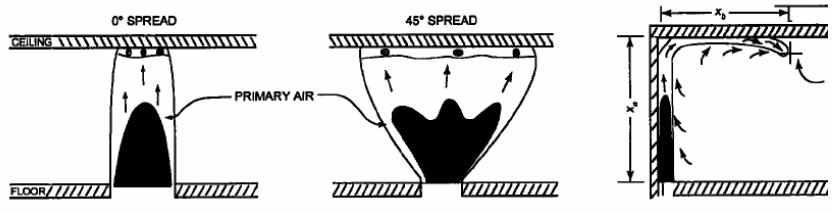
HEATING SYSTEMS



Schematic of an active solar heating system

- Scenario 1:
  - Solar panels
  - Utilization of waste heat from server room
- Scenario 2:
  - CHP plant (43MW of heating)

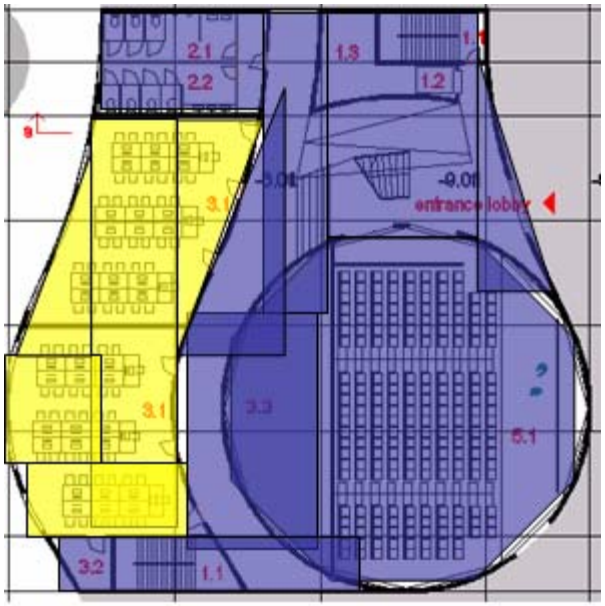
COOLING & HEATING APPARATUS

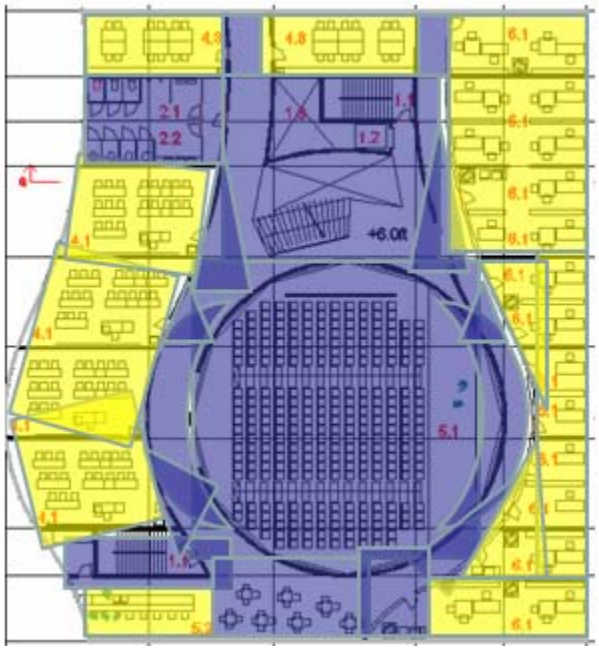


- Floor air diffusers
  - Concentrated along exterior of the room

- Chilled beams – passive
  - Of various lengths and widths
  - Of constant height =147mm
  - Spanning parallel to beams

SYSTEM LAYOUT – CONCEPT 1





ALL AIR

CHILLED BEAMS

WAVE

SYSTEM LAYOUT – CONCEPT 2

NATURE

INTEAGRATION - ARCHITECTURALLY

STANDARD UNPROTECTED GLASS

Concept 1 - Solar Gain		
		kw
Level 1	=	0
Level 2	=	48.03399
Level 3	=	66.2

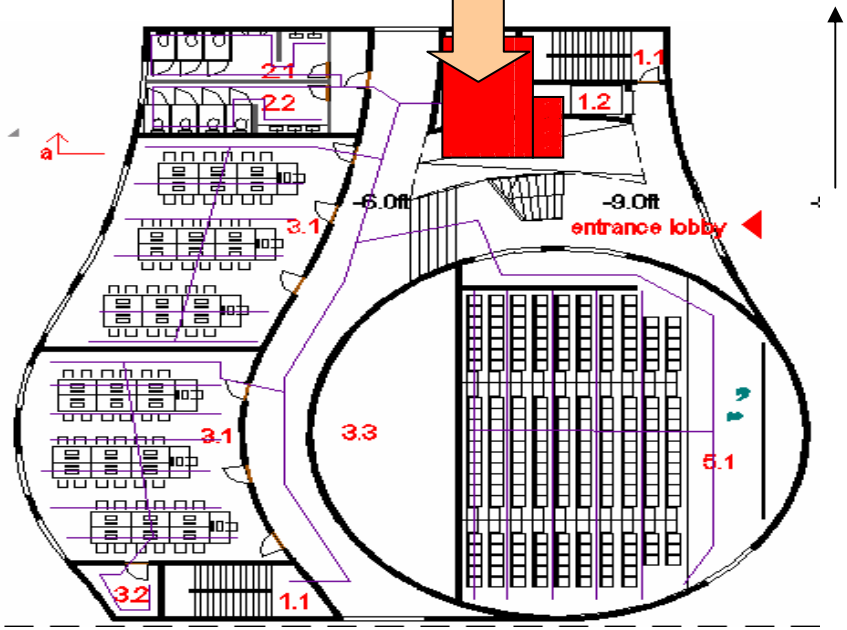
Concept 2 - Solar Gain		
		kW
Level 1	=	7.232
Level 2	=	74.15
Level 3	=	76.05

	kW
North	10.1
South	17.5
East	46.7
West	31.5

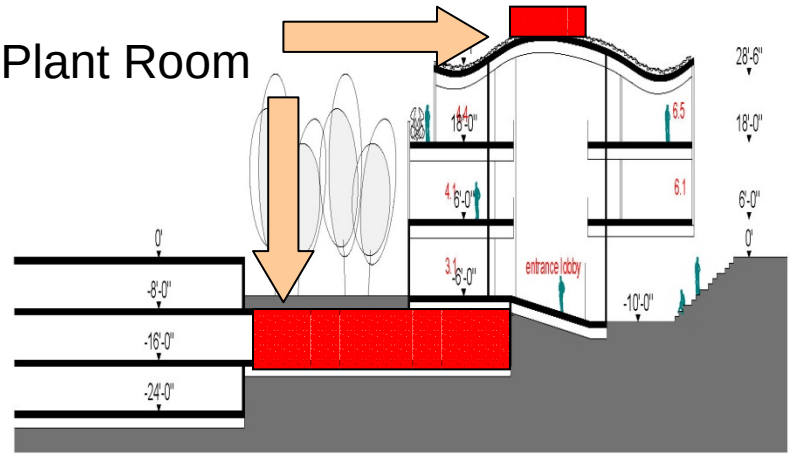
	kW
North	10
South	29.8
East	52.05
West	49.8818

CONCEPT 1

Mechanical Shaft



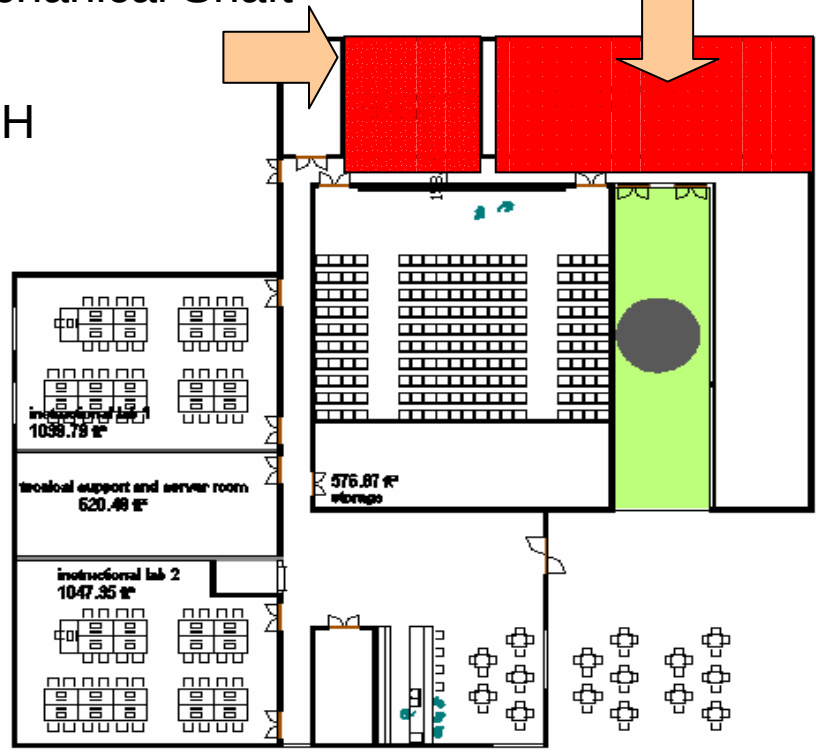
Plant Room



CONCEPT 2

Mechanical Shaft

Plant Room

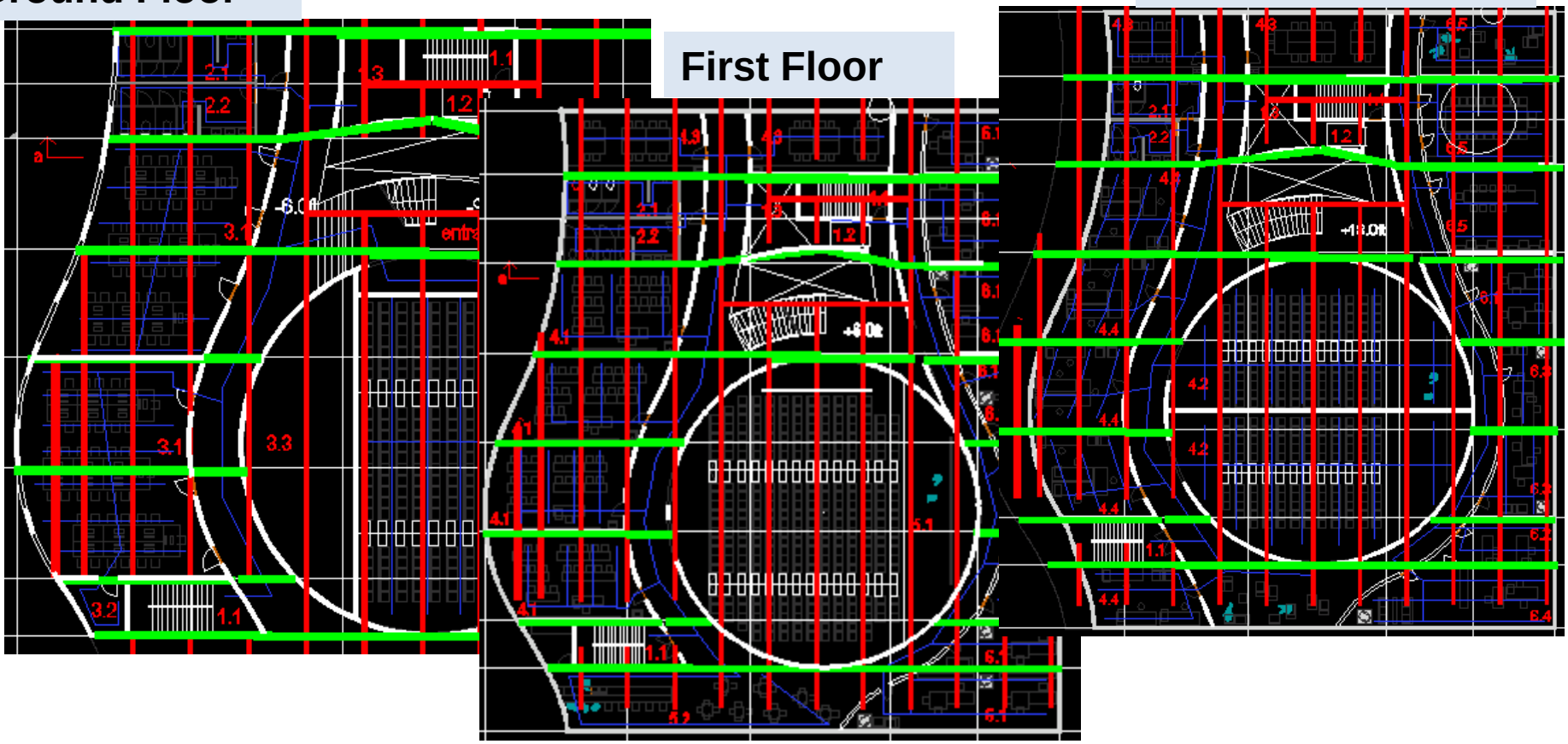


INTEGRATION - STRUCTURALLY

Ground Floor

First Floor

Second Floor



<u>CONCEPT 1</u> :

No. of Beam Cuts = 224

Overall Weight of Chilled Beams = 405.2 kg

Ducts:

Beams:

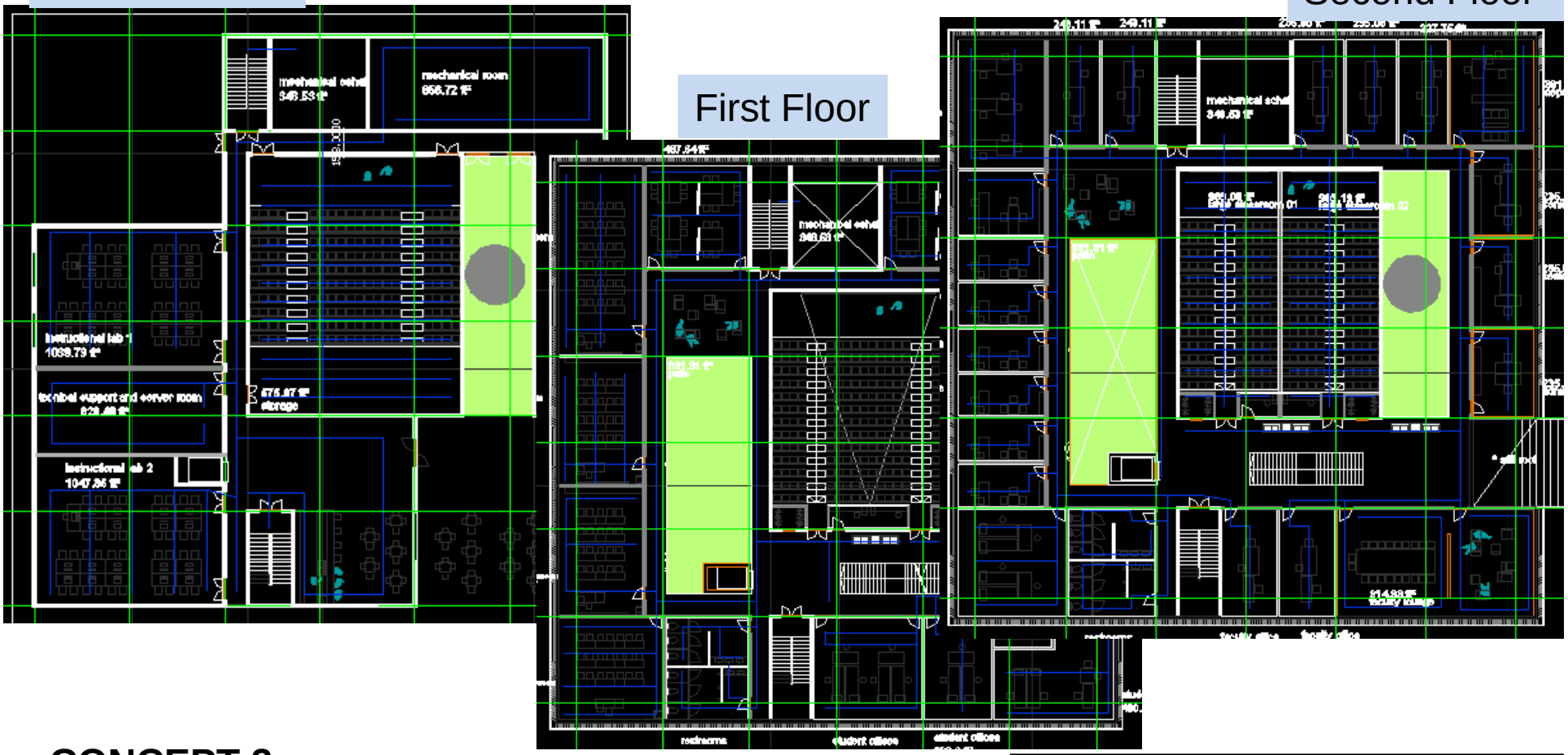
Girders:

INTEGRATION - STRUCTURALLY

Ground Floor

First Floor

Second Floor



CONCEPT 2 :

No. of Beam Cuts = 233

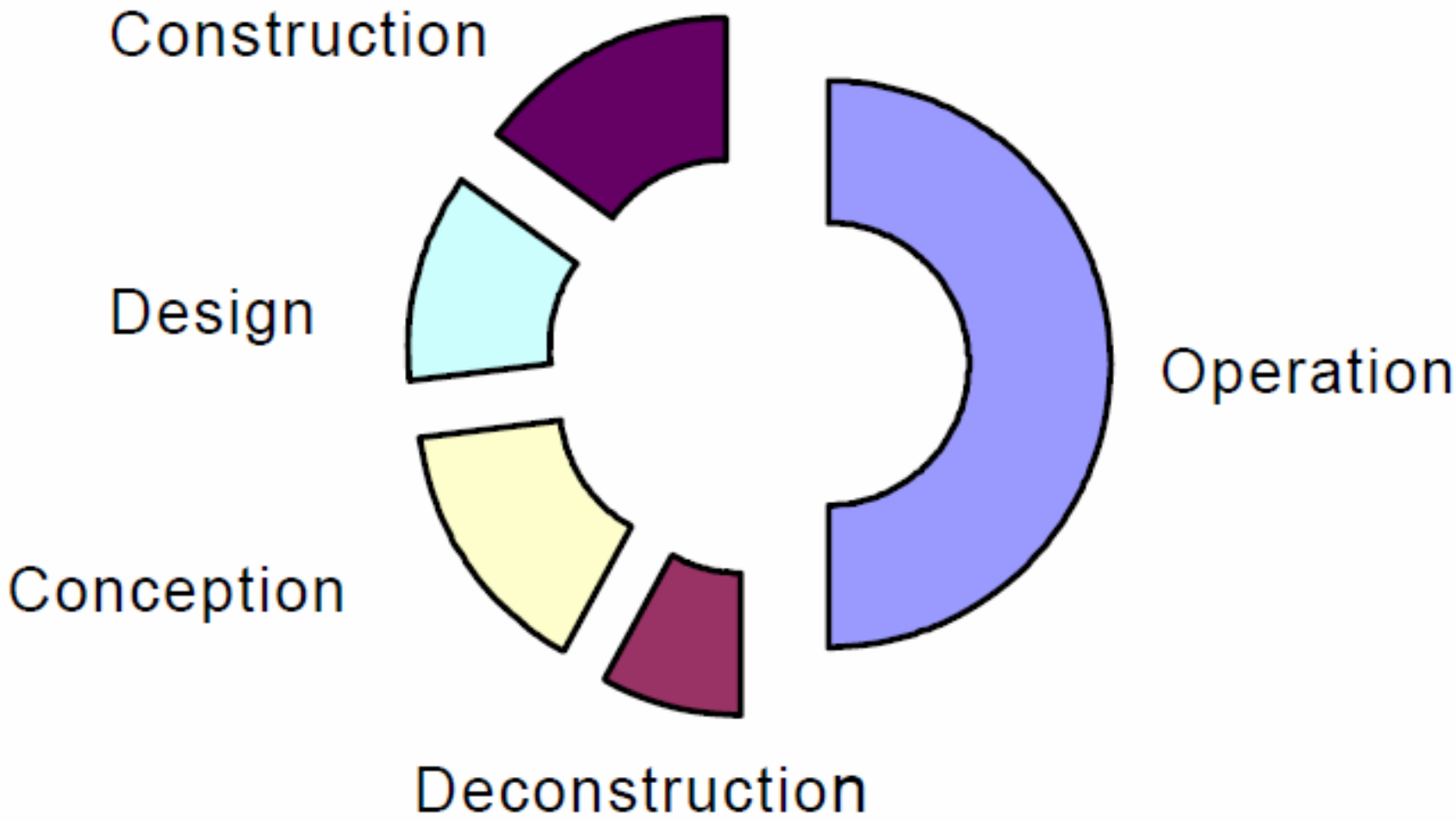
Overall Weight of Chilled Beams = 308.8 kg

Ducts:

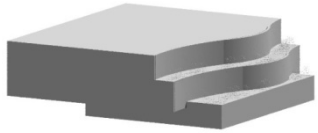
Beams:

Girders:

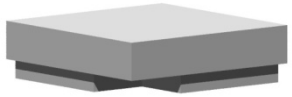
PHASES OF A REAL ESTATE LIFE CYCLE



GROSS FLOOR AREA



33,658



36,875

Net usable area

32,969

36,446

Net assignable area

21,980

25,995

Audi-torium

Labs

Class-rooms

Lounge

Offices

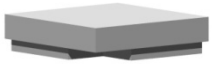
Non assignable area

10,989

10,451

Structural area

689

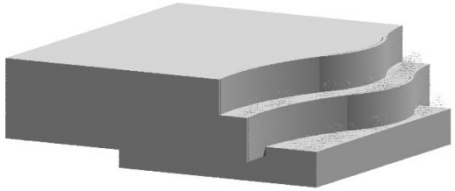


429

INDICATORS TO MEASURE THE ECONOMICAL EFFICIENCY

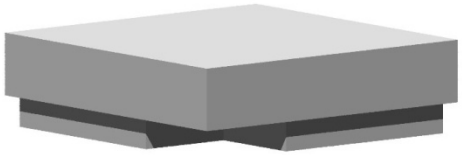
Usable floor area / gross floor area	>	0.6	ufa/gfa
Building volume / gross floor area	=	3.0	v/gfa
Surface / Volume Ratio	<	0.25	s/v
Circulation area / usable floor area	small as possible		ca/ufa

WAVE



Ufa/gfa	~ 0.65	↓
v/gfa	~ 3.66	↔
S/V	~ 0.22	↑
Ca/ufa	~ 0.43	↓

NATURE

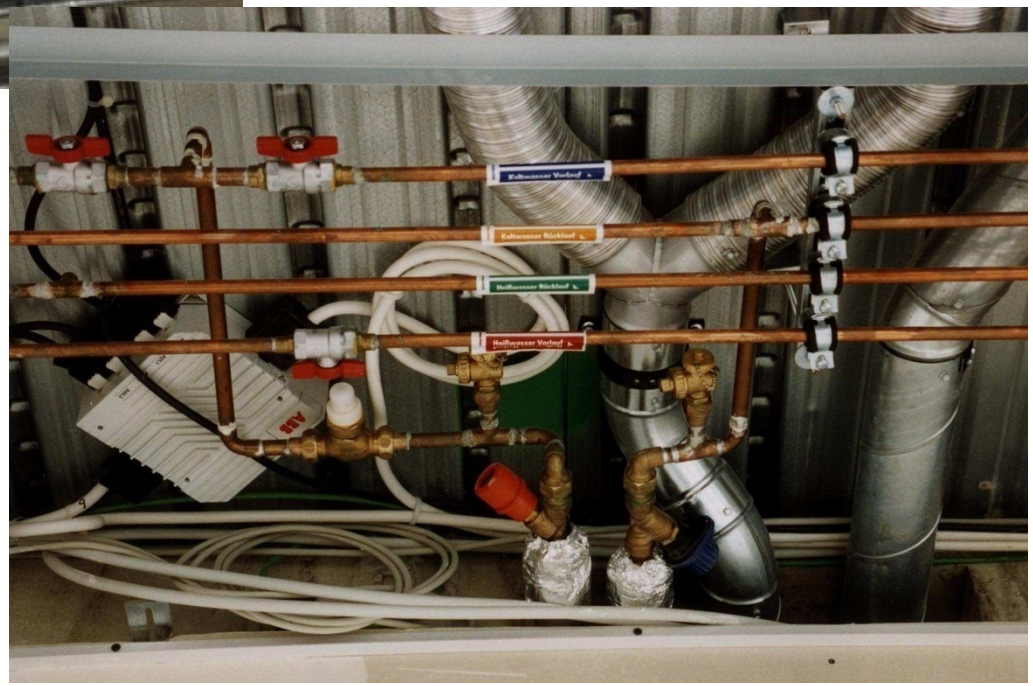


Ufa/gfa	~ 0.70	↑
v/gfa	~ 3.66	↔
S/V	~ 0.27	↓
Ca/ufa	~ 0.29	↑

CONSTRUCTION RULES CONSIDERED TO THE LIFE CYCLE

Flexibility of ventilation
- Movable covers on every axle

Flexibility of lighting
- Use BUS-System



Flexibility of air conditioning
- Valves on every axle

Always ensure a good accessability

FINANCE MODEL -PPP-

Public

Contractors

Project Team

Partnership

Bank

Private

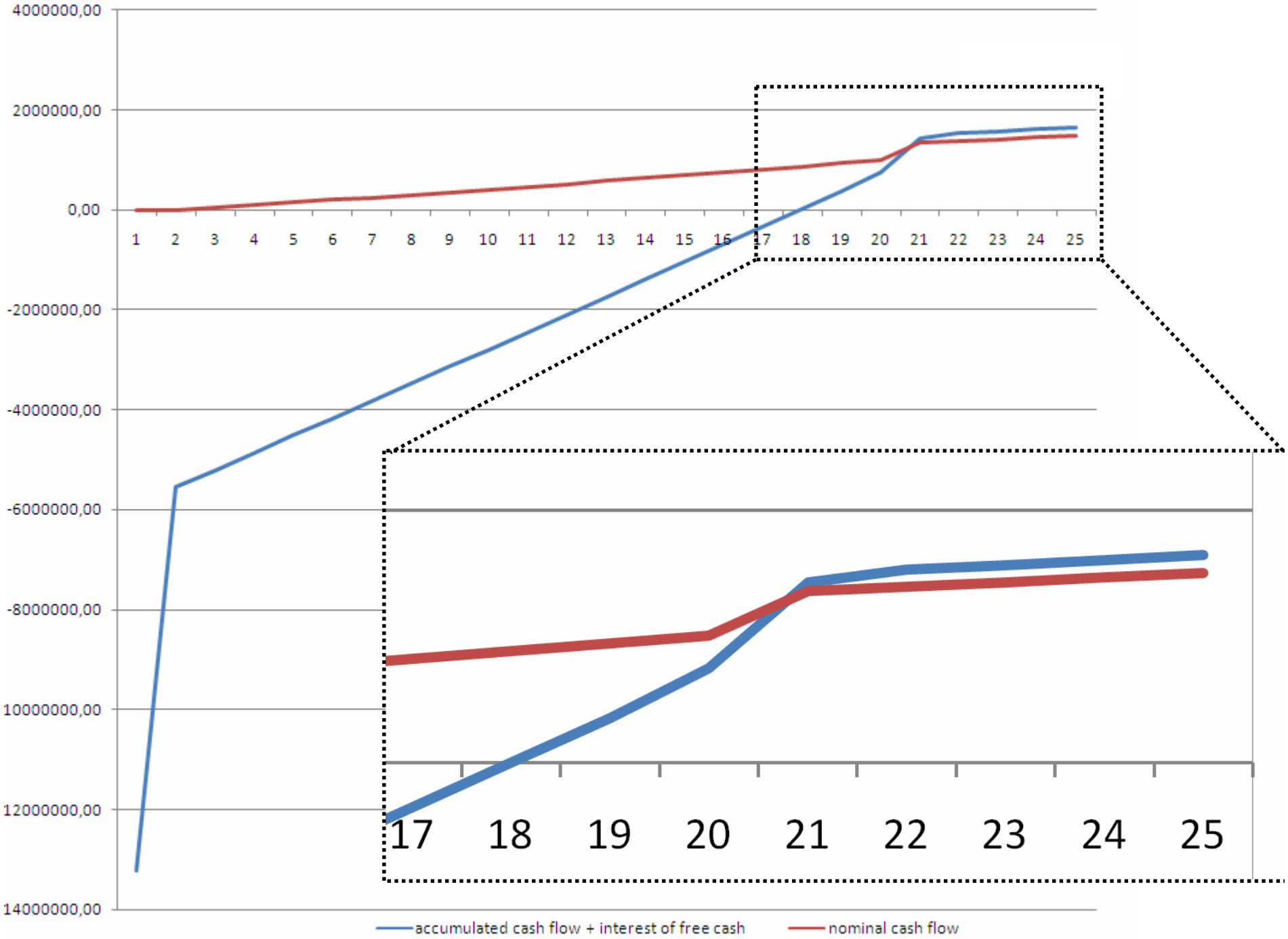
Investor

PRELIMINARY CASH FLOW MODEL

year	2015 1	2016 2	2017 3	2018 4
Construction costs	6500000,00	0,00	0,00	0,00
financial costs				
loan	5850000,00	5557500,00	5265000,00	4972500,00
interest 10%	585000,00	555750,00	526500,00	497250,00
paying back	292500,00	292500,00	292500,00	292500,00
Life cycle costs				
Operation costs	0,00	150000,00	153750,00	157593,75
Service costs	0,00	86000,00	88150,00	90353,75
Maintenance costs	0,00	210000,00	215250,00	220631,25
total expenses	7377500,00	1294250,00	1276150,00	1258328,75
expenses + loan	13227500,00	6851750,00	6541150,00	6230828,75
revenues				
bank loan	5850000,00			
equity	650000,00			
start up	877500,00			
rental fee	0,00	1294250,00	1326606,25	1359771,41
total revenues	7377500,00	1294250,00	1326606,25	1359771,41
Cash flows				
accumulated cash flow	-13227500,00	-5557500,00	-5214543,75	-4871057,34
investment of free cash 5%				
accumulated cash flow + interest of free cash	-13227500,00	-5557500,00	-5214543,75	-4871057,34
nominal cash flow	0,00	0,00	50456,25	101442,66

PRELIMINARY CASH FLOW MODEL

	A	R	S	T	U	Y	Z
1							
2	year	2031	2032	2033	2034	2038	2039
3		17	18	19	20	24	25
4							
5	Construction costs	0,00	0,00	0,00	0,00	0,00	0,00
6							
7	financial costs						
8	loan	1170000,00	877500,00	585000,00	292500,00	0,00	0,00
9	interest 10%	117000,00	87750,00	58500,00	29250,00	0,00	0,00
10	paying back	292500,00	292500,00	292500,00	292500,00	0,00	0,00
11							
12	Life cycle costs						
13	Operation costs	217244,72	222675,84	228242,74	233948,81	258235,71	264691,60
14	Service costs	124553,64	127667,48	130859,17	134130,65	148055,14	151756,52
15	Maintenance costs	304142,61	311746,18	319539,83	327528,33	361529,99	370568,24
16							
17	total expenses	1055440,98	1042339,51	1029641,74	1017357,79	767820,84	787016,36
18							
19	expenses + loan	2225440,98	1919839,51	1614641,74	1309857,79	767820,84	787016,36
20							
21	revenues						
22	bank loan						
23	equity						
24	start up						
25	rental fee	1874459,90	1921321,40	1969354,43	2018588,30	2228143,78	2283847,38
26							
27	total revenues	1874459,90	1921321,40	1969354,43	2018588,30	2228143,78	2283847,38
28							
29	Cash flows						
30	accumulated cash flow	-350981,08	1481,89	354712,69	708730,51	1460322,94	1496831,01
31	investment of free cash 5%			148,19	35471,27	142470,53	146032,29
32	accumulated cash flow + interest of free cash	-350981,08	1481,89	354860,88	744201,78	1602793,47	1642863,31
33							
34	nominal cash flow	819018,92	878981,89	939712,69	1001230,51	1460322,94	1496831,01


4000000,00
2000000,00
0,00
-2000000,00
-4000000,00
-6000000,00
-8000000,00
10000000,00
12000000,00
14000000,00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
17 18 19 20 21 22 23 24 25
accumulated cash flow + interest of free cash
nominal cash flow

PRELIMINARY RISK TEMPLATE

Risk name/ category	Description	Consequences	Risk Allocation		AEC Responsibility	Risk Management
			Contractor Risk	Owner Risk		
Construction period						
unexpacted soil-conditions	problems with the foundation, because of not knowing accurate soil conditions and didn´t take a soil sample	additional costs because of crossing the timeframe, need a newconcept for foundation	X		CM+E	push the research on soil conditions to get accurate data
subsequent dem of the owner	owner needs					
Operation period						
higher operating costs	price for electricity, water, gas increases over the time	additional cost for the project company, that means less profit	X		LCFM+MEP	use buffer in the calculation, expact inflation, use innovative HVAC system
inadequa delivery		need extra sources				make sure the HVAC
Maintenance period						
unexpacted enviromantal influence	bad weather conditions, earthquakes or fires cause a higher load of the material	additional unexpacted life cycle costs	X	X	CM+E+LCFM	good research on weather data, have a buffer in the life cycle costs for unexpacted maintenance
Services						
labor slack	employees that are qualified quit, hard to find qualified employees	inadequat delivery, less comfort quality, additional costs to search for employees	X	X	LCFM+A+E+Cm	use material that is easy to clean (qualification not nessecary), have reliable co-contractors

PRELIMINARY RISK TEMPLATE

	A	B	C	D	E	F	G
1	Risk name/ category	Description	Consequences	Risk Allocation		AEC Responsibility	Risk Management
2				Contractor Risk	Owner Risk		
3							
4							
5							
6	**Construction period**						
7	unexpacted soil-conditions	problems with the foundation, because of not knowing accurate soil conditions and didn´t take a soil sample	additional costs because of crossing the timeframe, need a newconcept for foundation	X		CM+E	push the research on soil conditions to get accurate data
8	subsequ of the ov						
16							
17	**Operation period**						
18	higher operating costs	price for electricity, water, gas increases over the time	additional cost for the project company, that means less profit	X		LCFM+MEP	use buffer in the calculation, expact inflation, use innovative HVAC system
19	inad deliv		need extra sources				make sure the HVAC
26							
27	**Maintenance period**						
28	unexpacted enviromantal influence	bad weather conditions, earthquakes or fires cause a higher load of the material	additional unexpacted life cycle costs	X	X	CM+E+LCFM	good research on weather data, have a buffer in the life cycle costs for unexpacted maintenance
35							
36	**Services**						
37	labor slack	employees that are qualified quit, hard to find qualified employees	inadequat delivery, less comfort quality, additional costs to search for employees	X	X	LCFM+A+E+Cm	use material that is easy to clean (qualification not nessecary), have reliable co-contractors

PRELIMINARY RISK TEMPLATE

Unexpacted enviromental influence

Risk allocation

Project Company ↙ ↘ Owner

- Additional costs for replacements
- Less available area

-Needs alternative usable area

PRELIMINARY RISK TEMPLATE

Unexpacted enviromental influence

Risk allocation

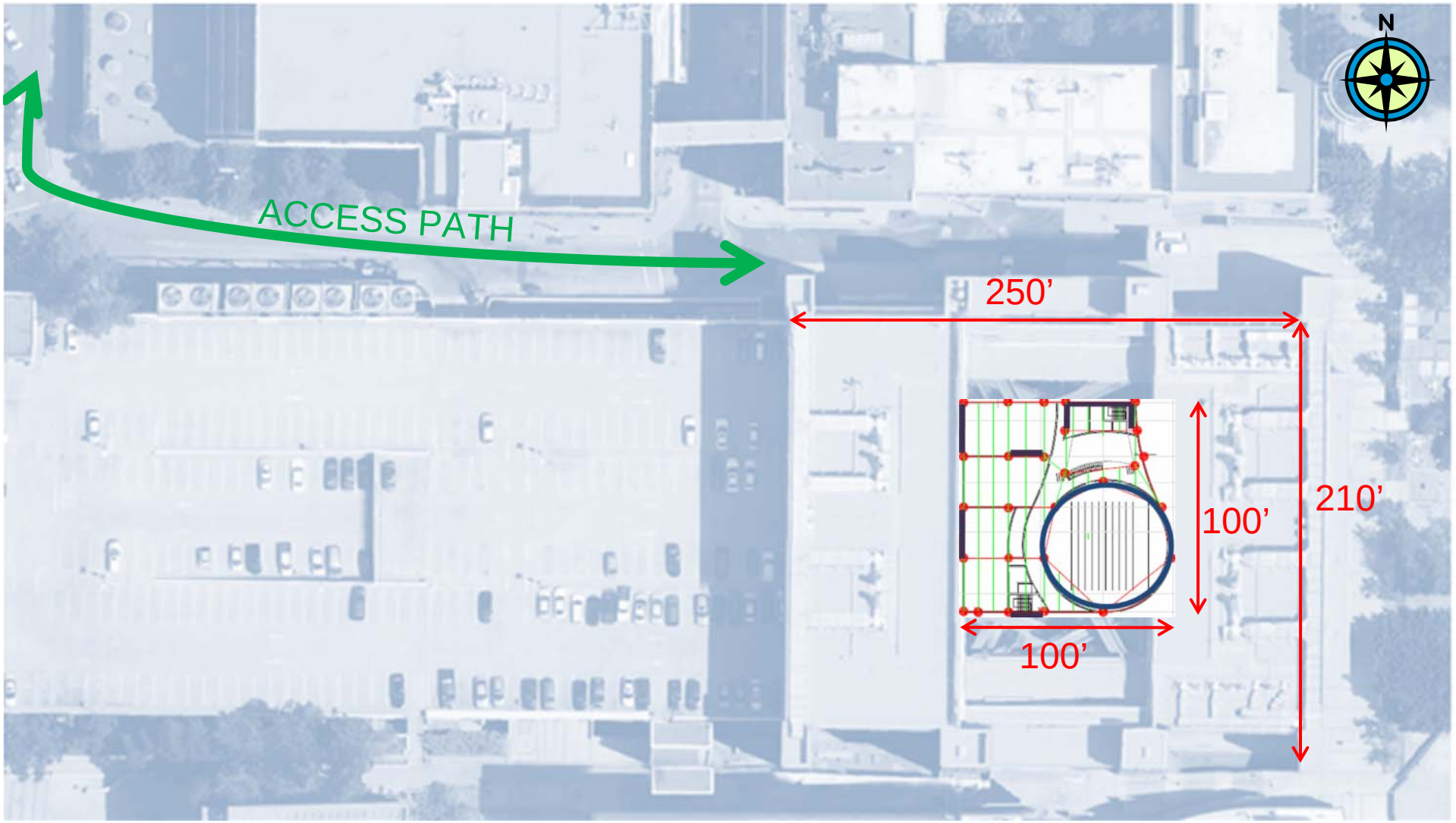
Project Company ↙ ↘ Owner

- Additional costs for replacements
- Less available area

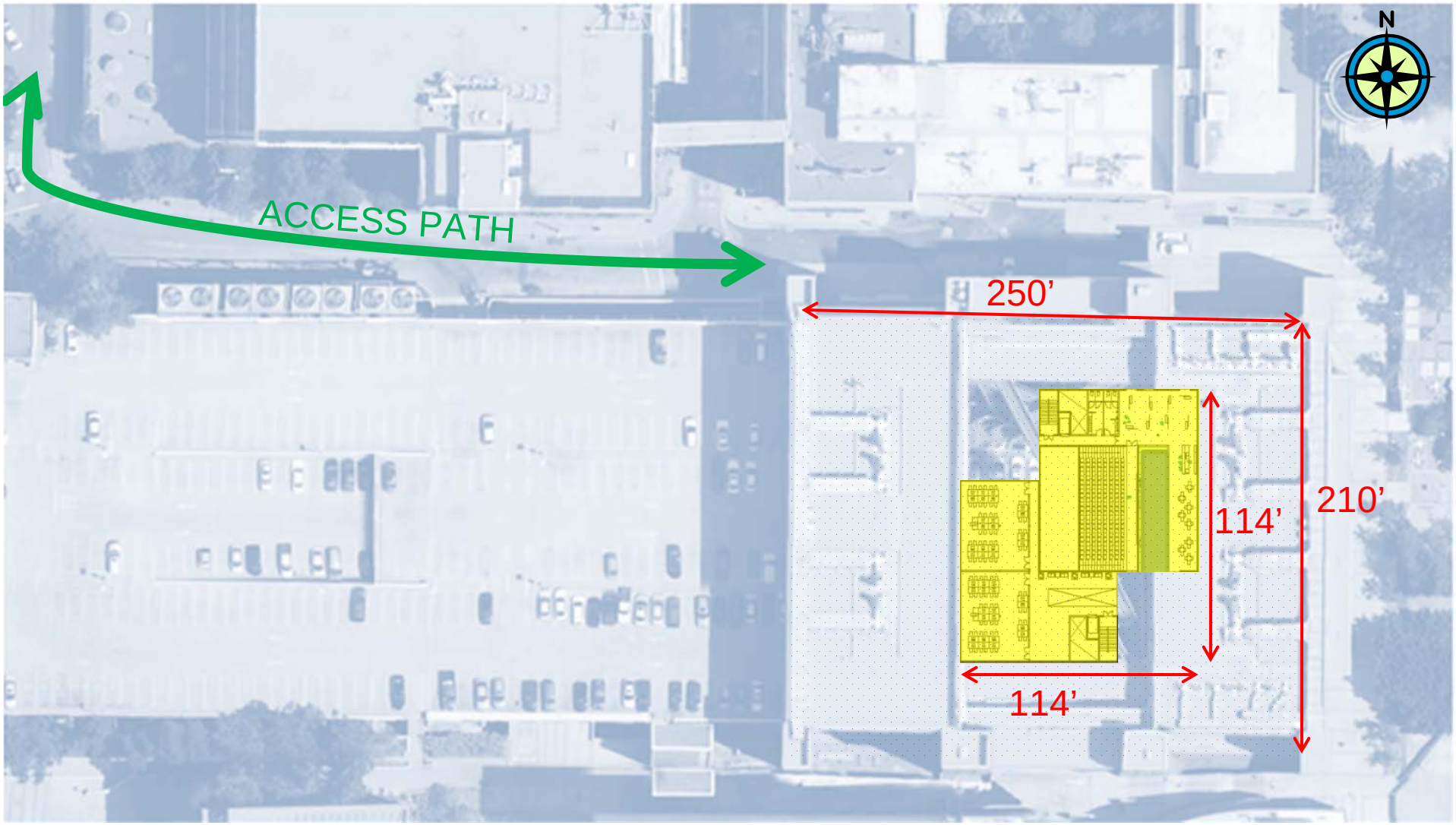
-Needs alternative usable area

Buffer life cycle costs
Create back up plan for alternative room use
Get insurance

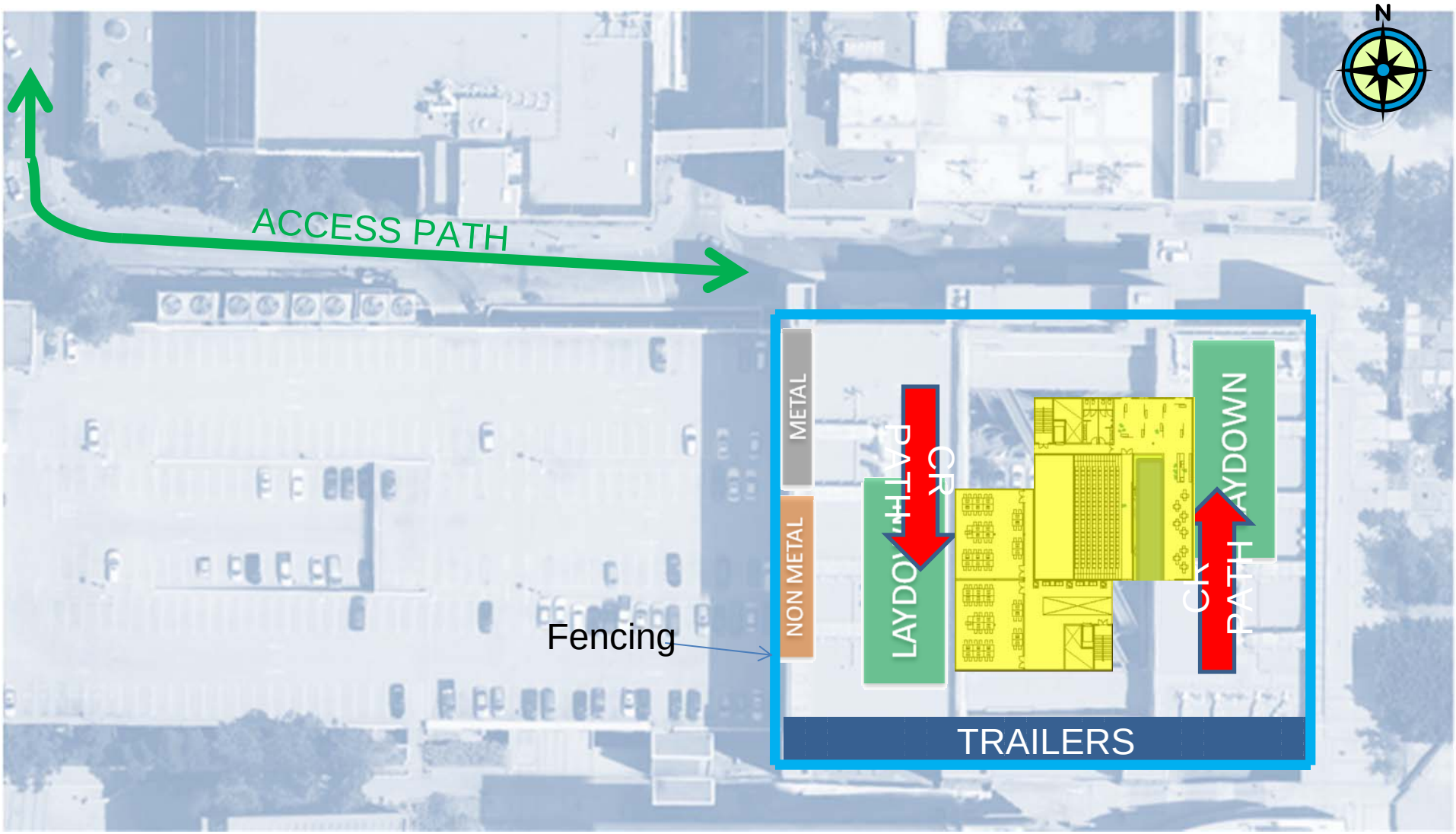
CONCEPT 1 “Wave”

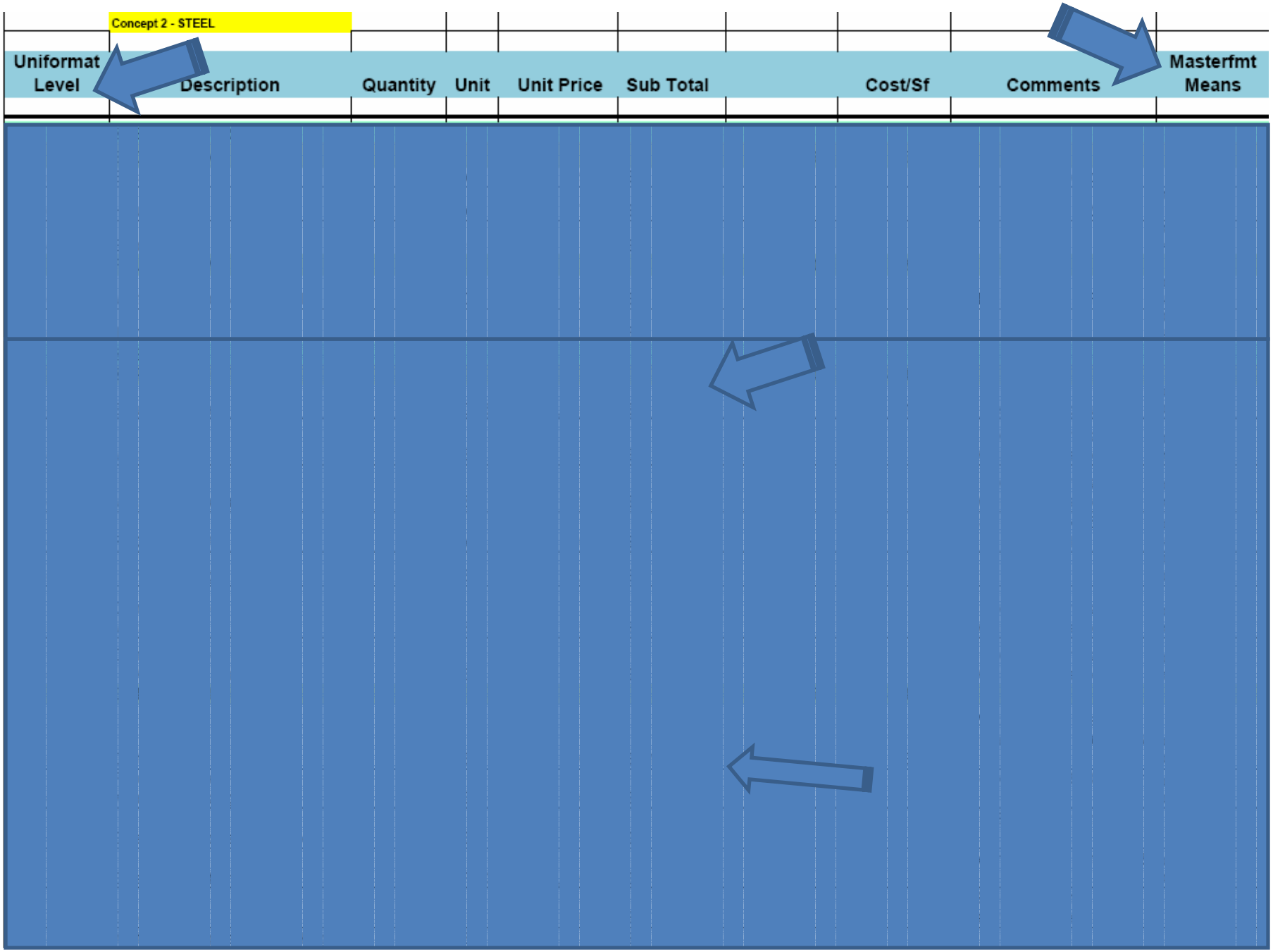


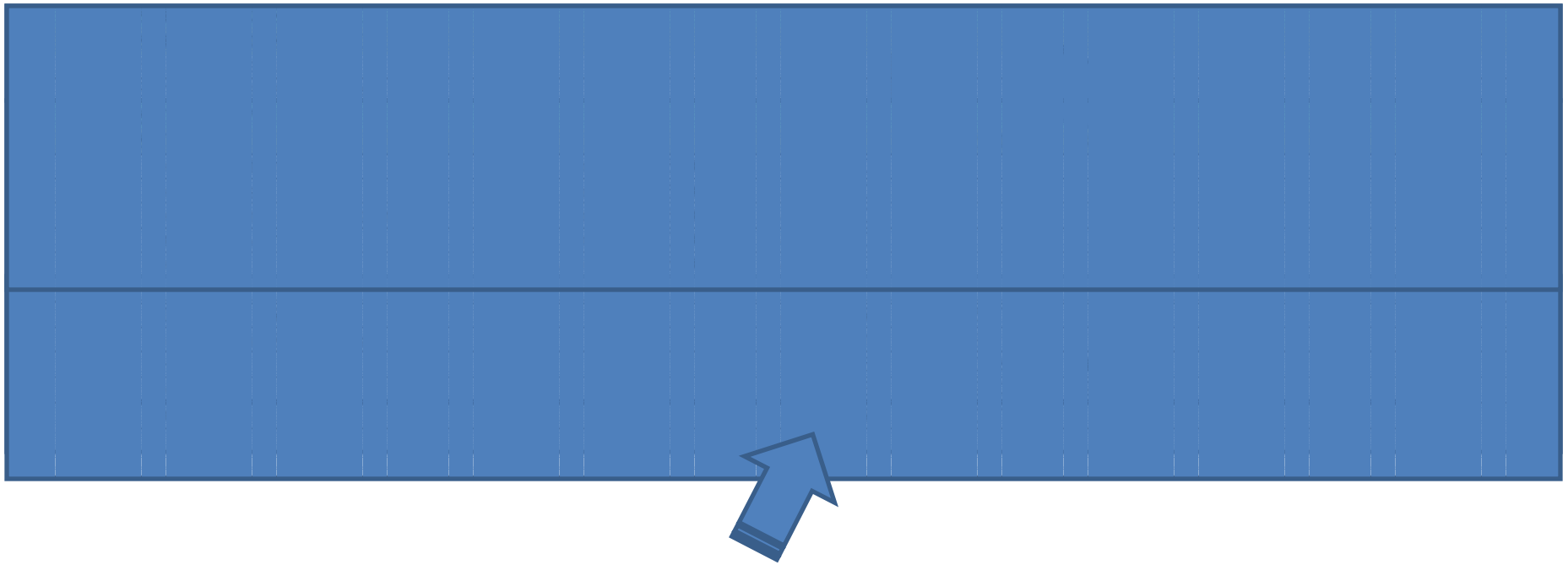
CONCEPT 2“Nature”



CRANE, LAYDOWN & TRAILERS
(During steel erection)



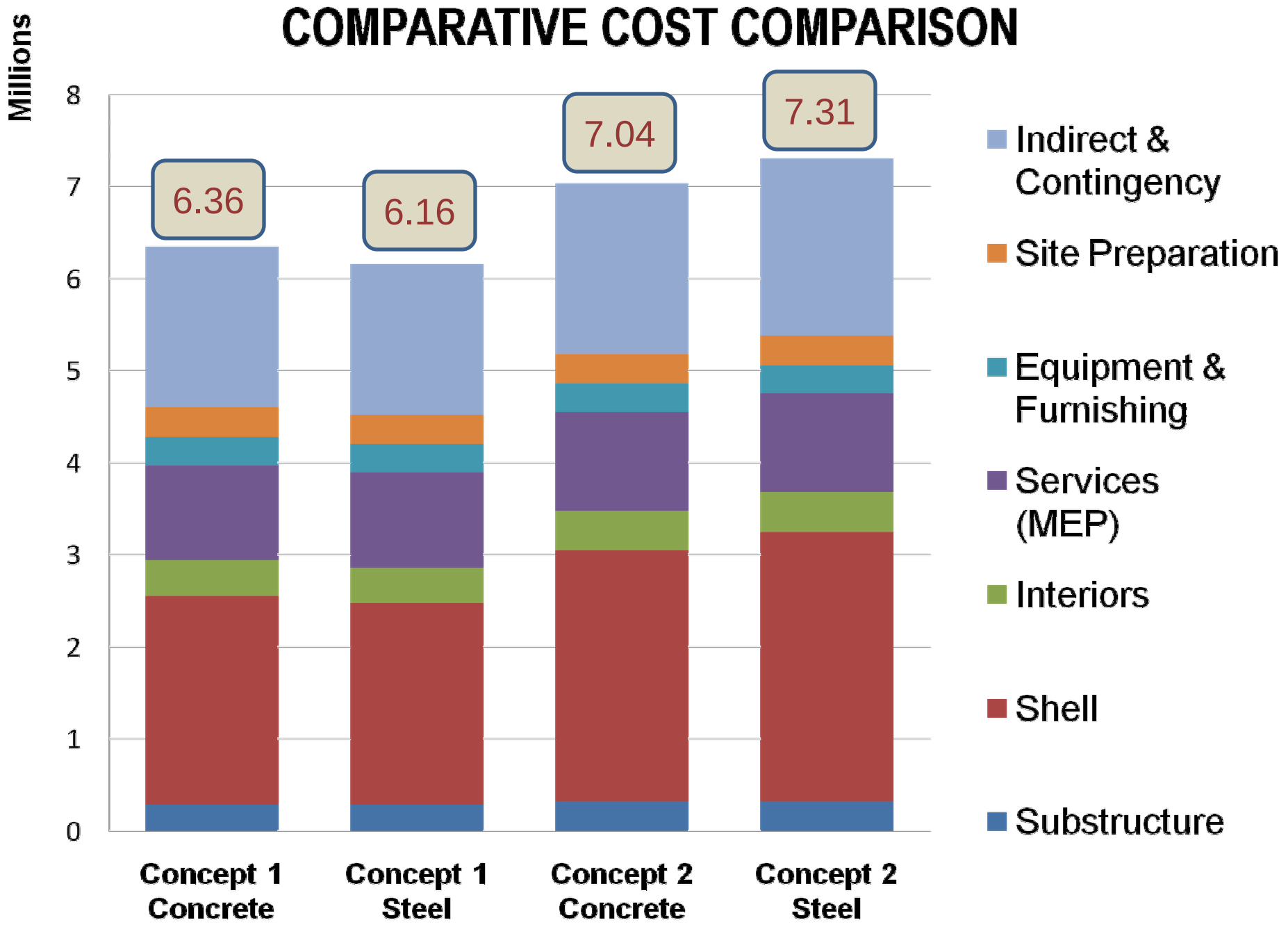

Concept 2 - STEEL
Uniformat Level
Description
Quantity
Unit
Unit Price
Sub Total
Cost/Sf
Comments
Masterfmt Means

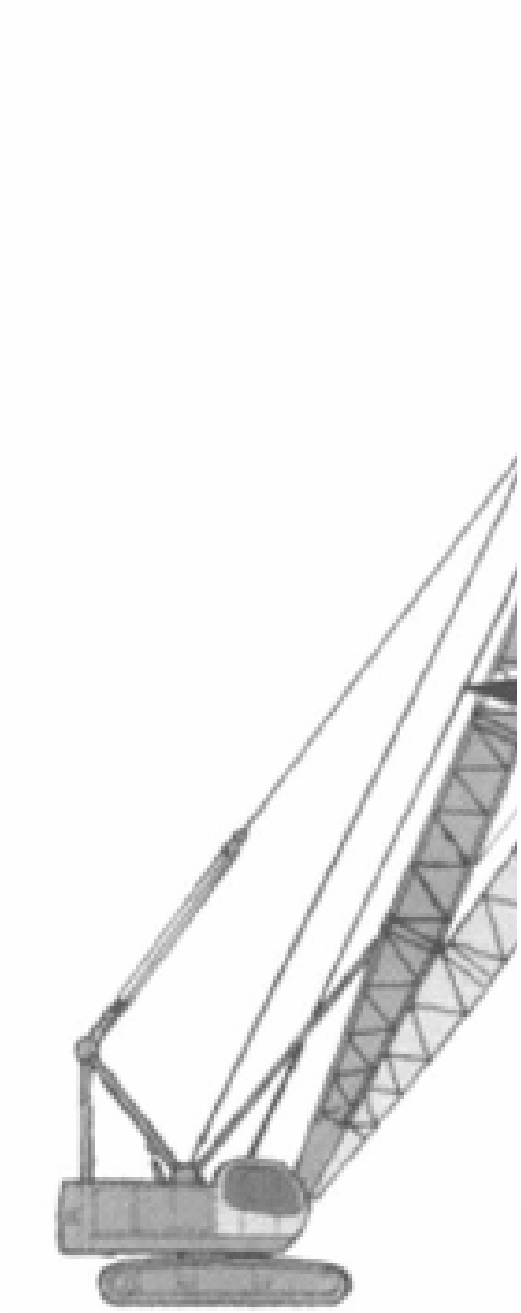


COST SUMMARY CONCEPT 2

"Nature" (Steel)

Level 1	Level 2	Level 2 Cost	Percent	Level 1 Cost	Per cent
Substructure	EXCAVATION	136653	2.5	332692	6.2
	FOUNDATION	196039	3.6		
Shell	SUPERSTRUCTURE	1172062	21.8	2922639	54.3
	EXTERIOR CLOSURE	1750578	32.5		
Interiors	INTERIOR CONSTRUCTION	169843	3.2	434681	8.1
	STAIRS	72024	1.3		
	INTERIOR FINISHES	192815	3.6		
Services (MEP)	CONVEYING SYSTEM	115500	2.1	1067710	19.8
	PLUMBING	154400	2.9		
	HVAC	342950	6.4		
	Fire Protection	93860	1.7		
	ELECTRICAL	361000	6.7		
Equipment & Furnishing	EQUIPMENT	23050	0.4	308050	5.7
	FURNISHING	285000	5.3		
Site Prep	SITEWORK	320000	5.9	320000	5.9
	Sub Total	**5385772**			
	INDIRECT COST	1928107			
	Total Cost	**7313879**			


COMPARATIVE COST COMPARISON
Millions
8
7
6
5
4
3
2
1
0
6.36
6.16
7.04
7.31
Concept 1 Concrete
Concept 1 Steel
Concept 2 Concrete
Concept 2 Steel
Indirect & Contingency
Site Preparation
Equipment & Furnishing
Services (MEP)
Interiors
Shell
Substructure

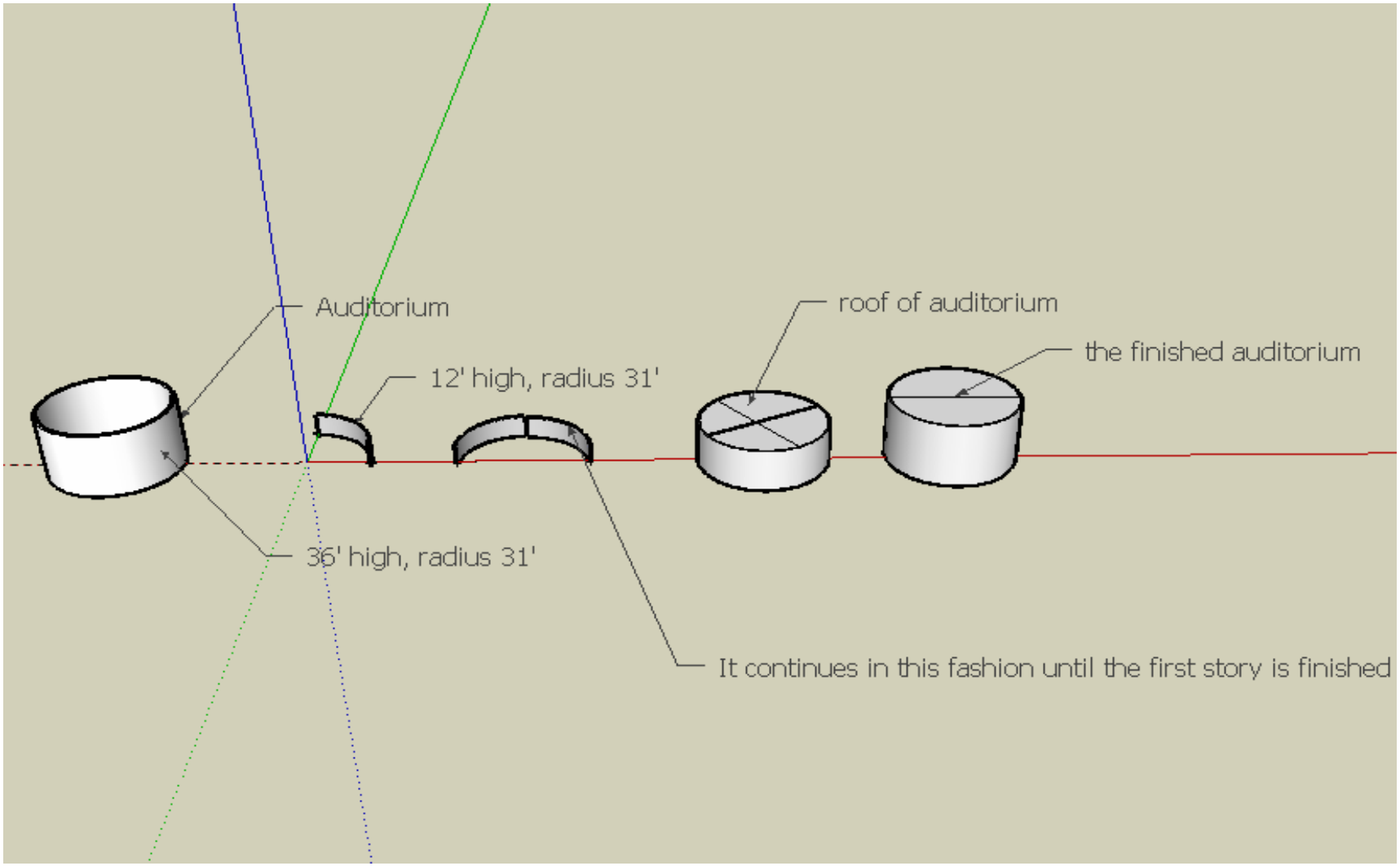


Phase 2

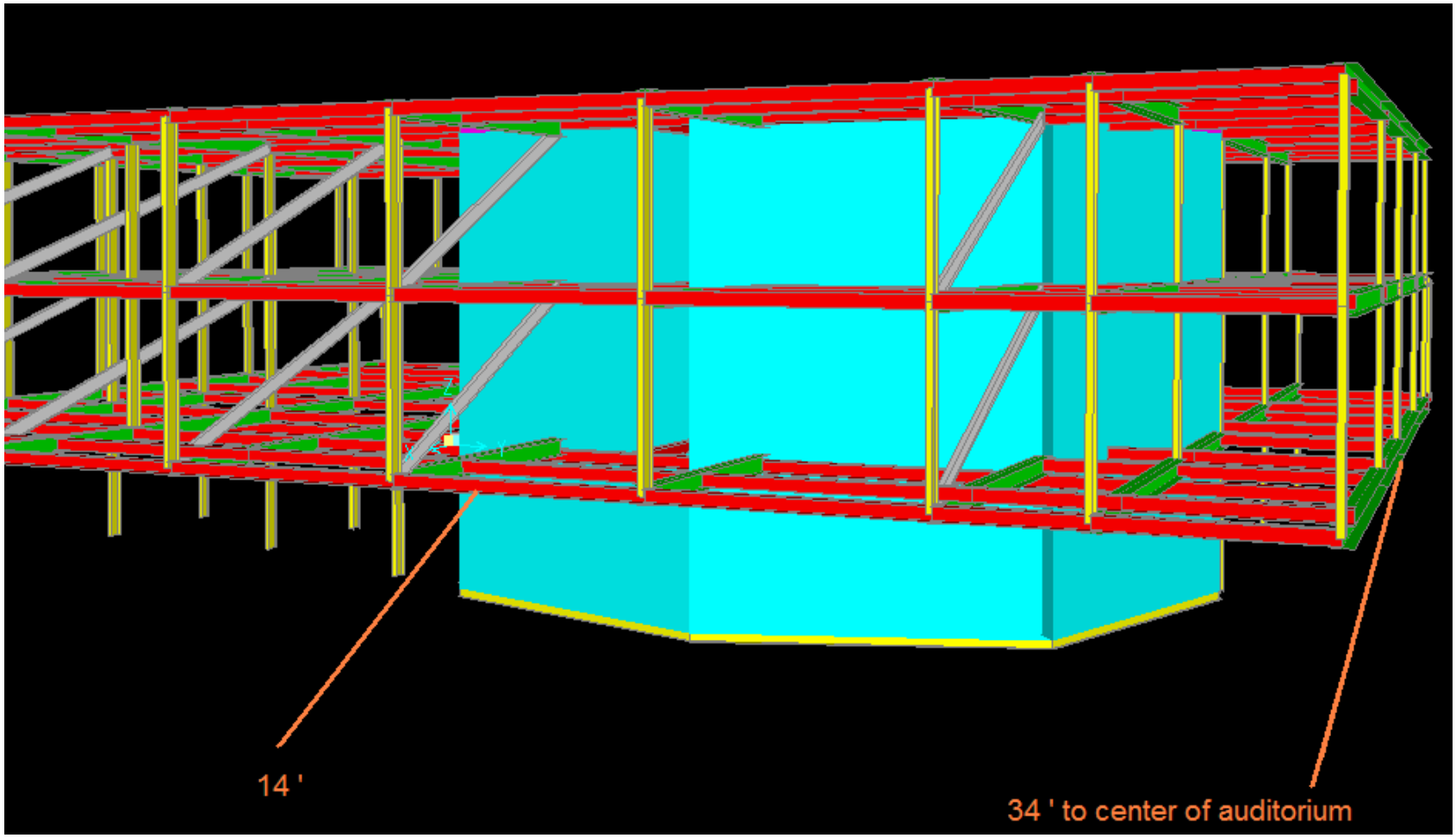
Wheel mounted Hydraulic

Phase 3

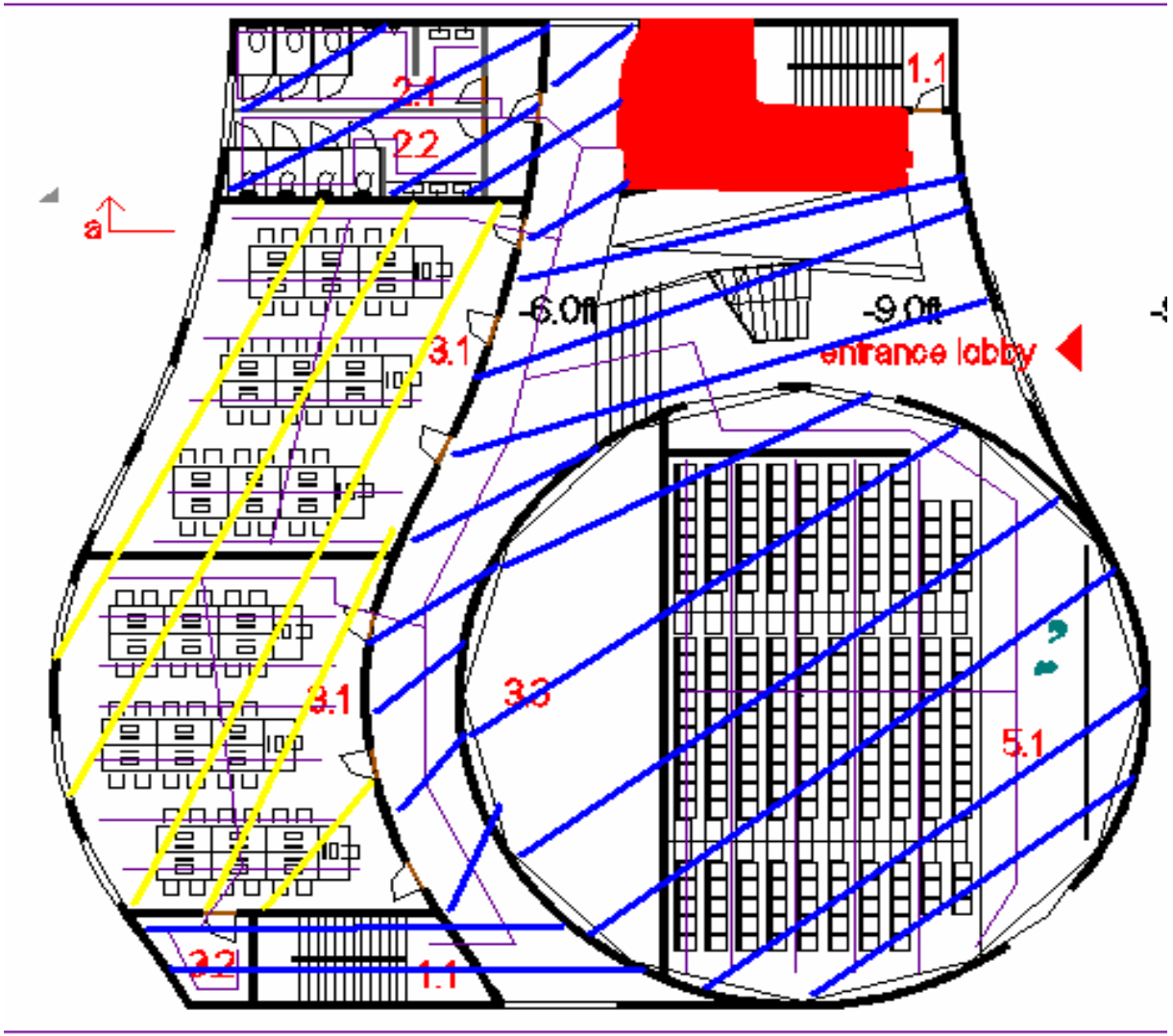
KEY PHASES - AUDITORIUM



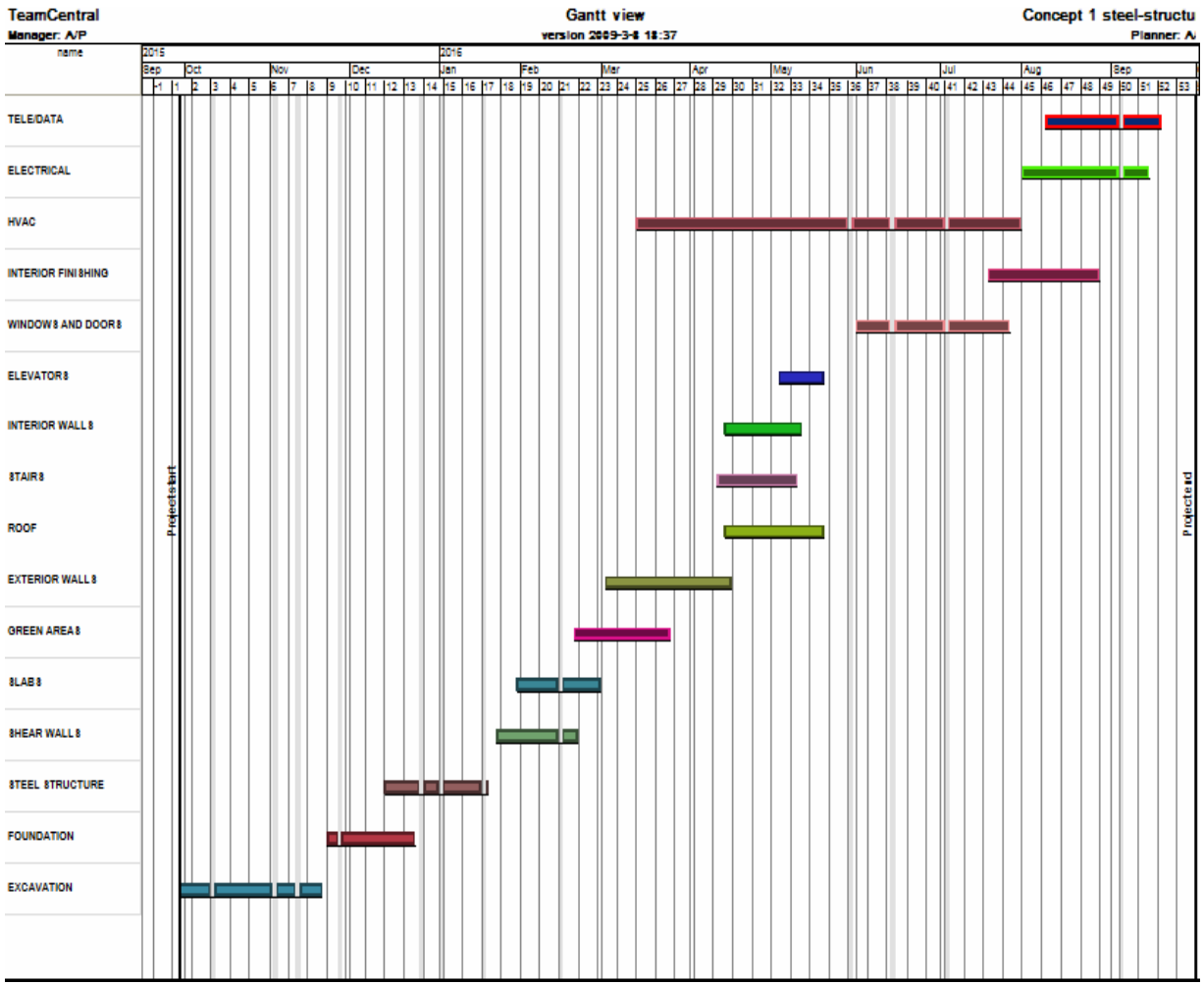
KEY PHASES - CANTILEVER



KEY PHASES – MECHANICAL ROOM

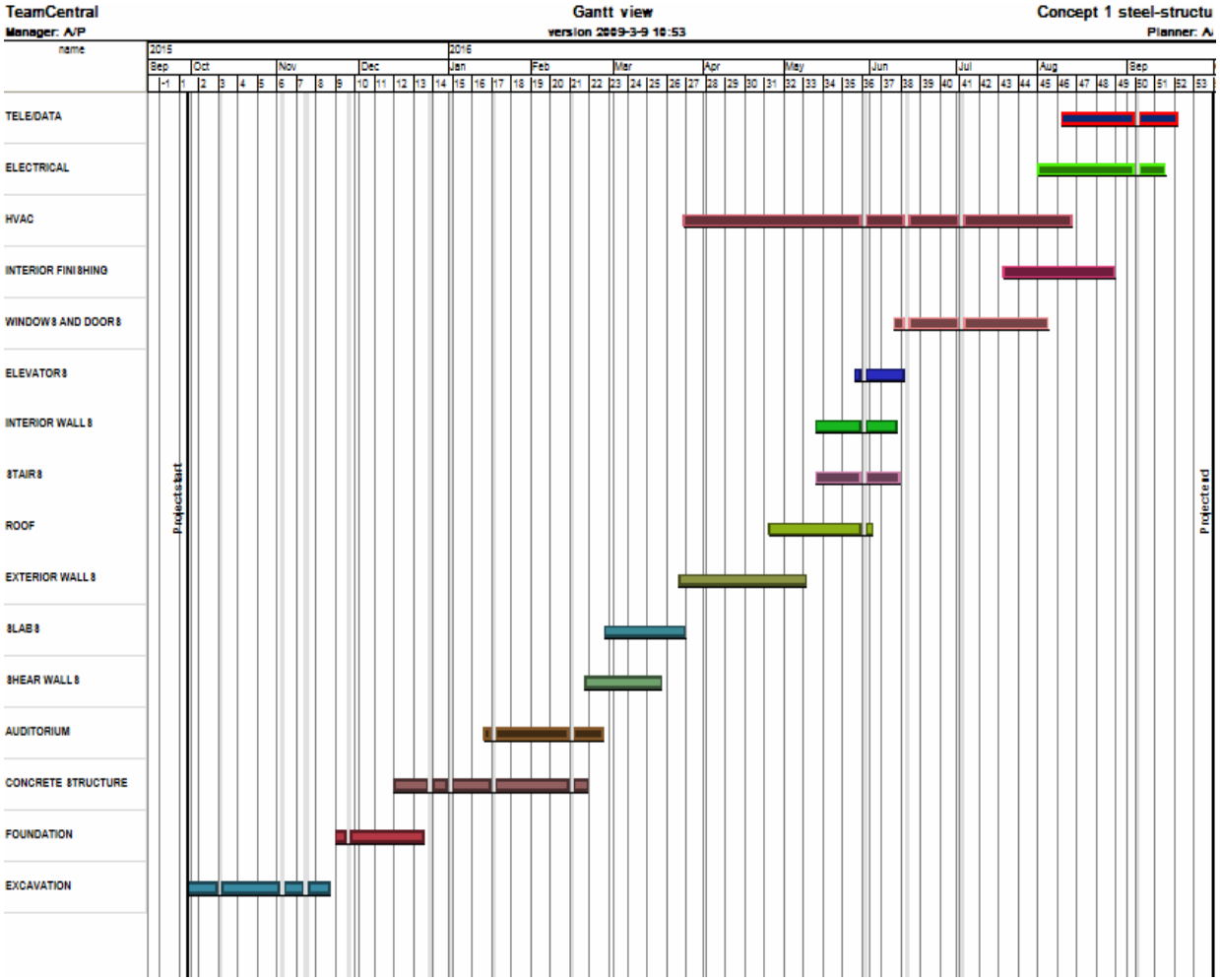


SCHEDULE: WAVE - STEEL



- Faster
- Time: lab
- Fire coating
- HVAC: time
- Auditorium: integration
- Rainseason
- Fluctuating prices

SCHEDULE: WAVE - CONCRETE



- Slower
- Affect site
- Time: lab
- cost
- HVAC: heat
- Auditorium: concrete
- Disturbance

LEED: SITE/WATER

Yes				
1			Prereq 1	**Construction Activity Pollution Prevention**
1			Credit 1	**Site Selection**
		1	Credit 2	**Development Density & Community Connectivity**
1			Credit 3	**Brownfield Redevelopment**
1			Credit 4.1	**Alternative Transportation**, Public Transportation
0		1	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms
0		1	Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel Efficient Vehicles
		1	Credit 4.4	**Alternative Transportation**, Parking Capacity
1			Credit 5.1	**Site Development**, Protect or Restore Habitat
1			Credit 5.2	**Site Development**, Maximize Open Space
1			Credit 6.1	**Stormwater Design**, Quantity Control
0		1	Credit 6.2	**Stormwater Design**, Quality Control
1			Credit 7.1	**Heat Island Effect**, Non-Roof
1			Credit 7.2	**Heat Island Effect**, Roof
			Credit 8	**Light Pollution Reduction**

Yes	?	No	
3		2	Water Efficiency
1			Credit 1.1 **Water Efficient Landscaping**, Reduce by 50%
		1	Credit 1.2 **Water Efficient Landscaping**, No Potable Use or No Irrigation
1			Credit 2 **Innovative Wastewater Technologies**
1			Credit 3.1 **Water Use Reduction**, 20% Reduction
		1	Credit 3.2 **Water Use Reduction**, 30% Reduction

Remarks

- Transportation
- Heat Island Effect
- Open Space
- Stormwater Design

LEED: ENERGY EFFICIENCY

Yes	?	No				
8		1	Energy & Atmosphere			17 Points
Yes			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**		Required
Yes			Prereq 1	**Minimum Energy Performance**		Required
Yes			Prereq 1	**Fundamental Refrigerant Management**		Required
				*Note for EAc1: All LEED for New Construction projects registered after June 26, 2007 are required to achieve at least two (2) points.		
4			Credit 1	**Optimize Energy Performance**		1 to 10
				Credit 1.1	10.5% New Buildings / 3.5% Existing Building Renovations	1
				Credit 1.2	14% New Buildings / 7% Existing Building Renovations	2
				Credit 1.3	17.5% New Buildings / 10.5% Existing Building Renovations	3
			-->	Credit 1.4	21% New Buildings / 14% Existing Building Renovations	4
				Credit 1.5	24.5% New Buildings / 17.5% Existing Building Renovations	5
				Credit 1.6	28% New Buildings / 21% Existing Building Renovations	6
				Credit 1.7	31.5% New Buildings / 24.5% Existing Building Renovations	7
				Credit 1.8	35% New Buildings / 28% Existing Building Renovations	8
				Credit 1.9	38.5% New Buildings / 31.5% Existing Building Renovations	9
				Credit 1.10	42% New Buildings / 35% Existing Building Renovations	10
1			Credit 2	**On-Site Renewable Energy**		1 to 3
			-->	Credit 2.1	2.5% Renewable Energy	1
				Credit 2.2	7.5% Renewable Energy	2
				Credit 2.3	12.5% Renewable Energy	3
1			Credit 3	**Enhanced Commissioning**		1
1			Credit 4	**Enhanced Refrigerant Management**		1
1			Credit 5	**Measurement & Verification**		1
		1	Credit 6	**Green Power**		1

Remarks

- Conservative
- Renewable Energy

LEED: MATERIALS & RESOURCES

Yes	?	No		
6		7	Materials & Resources	
Yes			Prereq 1	**Storage & Collection of Recyclables**
		1	Credit 1.1	**Building Reuse,** Maintain 75% of Existing Walls, Floors & Roof
		1	Credit 1.2	**Building Reuse,** Maintain 95% of Existing Walls, Floors & Roof
		1	Credit 1.3	**Building Reuse,** Maintain 50% of Interior Non-Structural Elements
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal
		1	Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal
1			Credit 3.1	**Materials Reuse**, 5%
		1	Credit 3.2	**Materials Reuse**, 10%
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + 1/2 pre-consumer)
		1	Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 pre-consumer)
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured
		1	Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured
1			Credit 6	**Rapidly Renewable Materials**
1			Credit 7	**Certified Wood**

Remarks

- Reuse
- Recycling
- Disposal
- Regional Materials
- Certified Wood
- Renewable

LEED: I.E.Q.

Yes	?	No		
9		5	Indoor Environmental Quality	
Yes			Prereq 1	**Minimum IAQ Performance**
Yes			Prereq 2	**Environmental Tobacco Smoke (ETS) Control**
1			Credit 1	**Outdoor Air Delivery Monitoring**
		1	Credit 2	**Increased Ventilation**
1			Credit 3.1	**Construction IAQ Management Plan,** During Construction
1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy
0		1	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants
0		1	Credit 4.2	**Low-Emitting Materials**, Paints & Coatings
0		1	Credit 4.3	**Low-Emitting Materials**, Carpet Systems
0		1	Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products
1			Credit 5	**Indoor Chemical & Pollutant Source Control**
1			Credit 6.1	**Controllability of Systems**, Lighting
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort
1			Credit 7.1	**Thermal Comfort,** Design
1			Credit 7.2	**Thermal Comfort,** Verification
1			Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces
			Credit 8.2	**Daylight & Views,** Views for 90% of Spaces

Remarks

- Ventilation
- Materials
- Controllability
- Daylight

LEED: RATING

- 37 points
- Conservative Estimate
- Silver Rating
- Room For Improvement

CONSTRUCTABILITY - REPLACEMENT

Concerns now

- Life-cycle – Time/Cost
- Alternate Use
- Retrofitting
- Adding More Stories

Concerns later

- Future Building Site
- Use During Replacement
- Replacement - Coordination
- New Regulation

ROOF, FACADE AND WINDOWS

Construction element	typical life expectation	
	start of operation phase	after expiration of contract
roof covering	20	min 15
facade	45	rest
windows	40	min 15

Roof

- Crane
- Replacable Materials

Facade:

- Coordinations Windows

Windows:

- Alterations Possible

INTERIORS

construction element	typical life expectation (years)	
	start of operation phase	after expiration of contract
inner partitions, opening	25	min 10
interior fittings	15	min 5
ceilings	25	min 10

Inner Partitions

- Coordination Fittings/Ceilings
- Flexiblity For Future Use

Interior Fittings

- Future Change

Ceilings

- Coordination HVAC
- Hygenic Consideration/Cleaning
- Lighting Consideration

HVAC AND INSTALLATION

construction element	typical life expectation (years)	
	start of operation phase	after expiration of contract
fittings, fixtures	15	min 5
sanitary equipment	20	min 10
mechanical equipment	acc. To term of reference	min 10
electrical equipment	acc. To term of reference	min 10
monitoring system	20	min 5
fire installations	20	min 5
elevators	20	min 5

HVAC/Installations

- **Independence From Structural System**

Data/Tele

- **Quick Replacement**
- **Wireless Future**

Elevator

- **During Replacement**

ZERO WASTE MANAGEMENT PLAN

Considerations:

- On-site Or Off-site
- Transportation Distance
- For What
- To Where

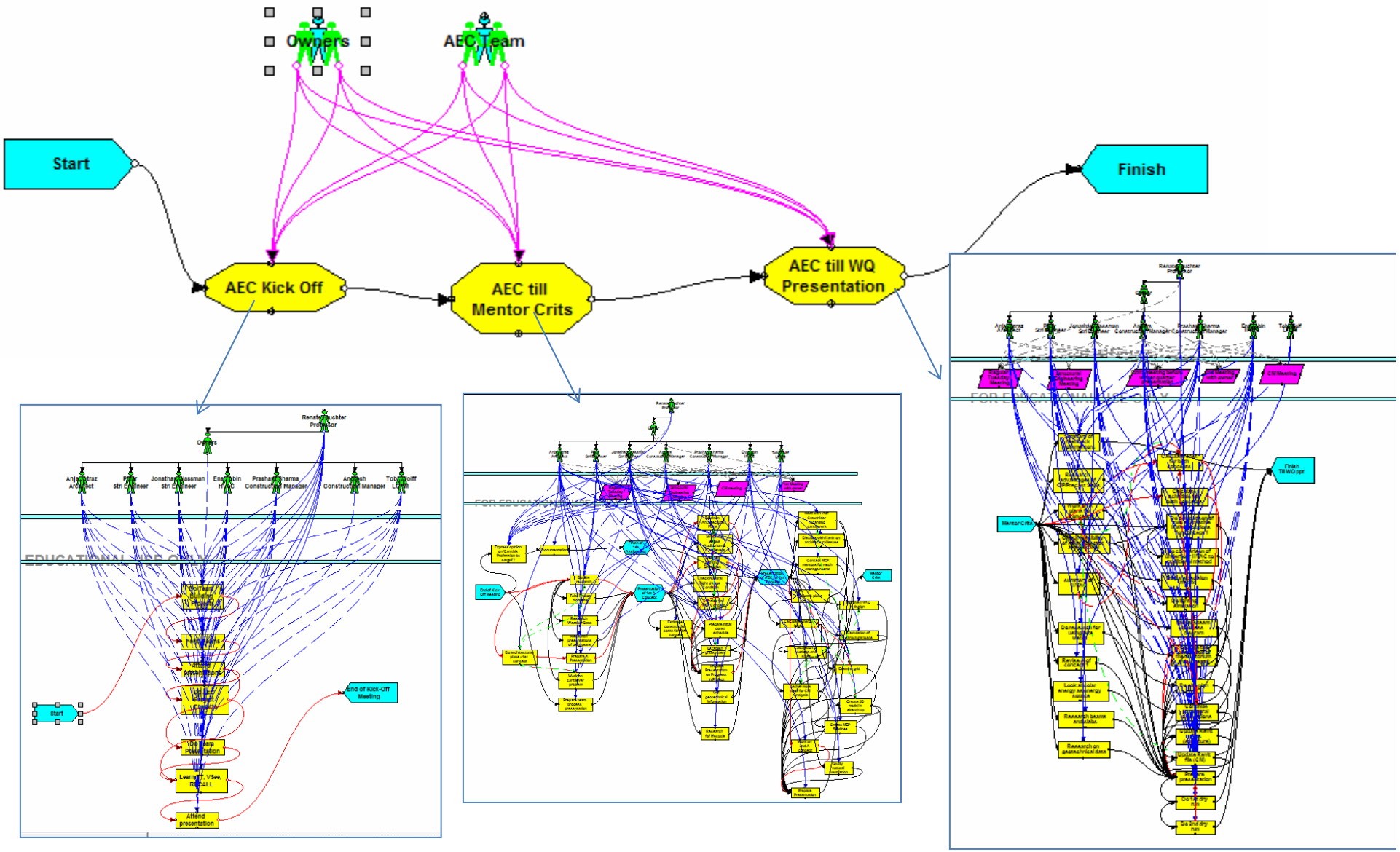
Possible Solutions:

- Materials
- Methods

Zero Waste Management Plan

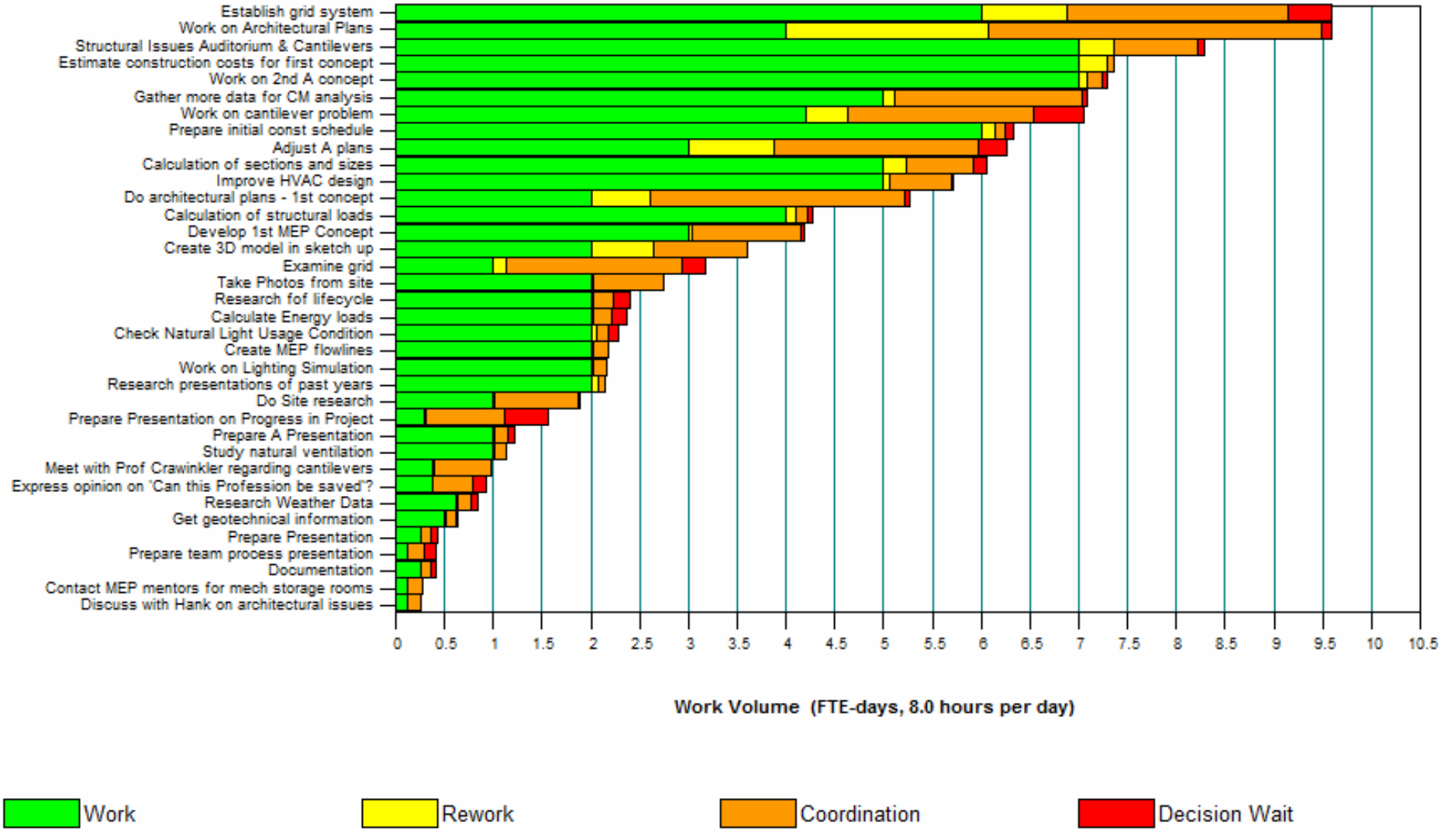
Part of building	subpart	product	Code	Production site	Transportation distance	What goes to waste	how much go	where does the
Site	Site clearance		11-1111	site	0			
	Dug excavations		11-1112	site	0			
Foundations	Footings		13-1211					
	Miscellaneous foundations		13-1213					
Ground floor	Ground floor		14-1221					
Connections and culverts	Sanitary sewer conncetion		15-2110					
	Water supply connection		15-2120					
	Electrical supply connection		15-2310					
	Telecommunications connection		15-2410					
Superstructure	Load bearing internal walls		21-1232					
	Columns		21-1233					
	Beams		21-1234					
	Intermediate floors		21-1235					
	Roof slabs		21-1236					
	Structural frame staircases		21-1237					
Facade	External Walls		31-1241					
	Windows		31-1242					
	External doors		31-1243					
	Facade complementaries		31-1244					
Roofs	Roof substructures		33-1261					
	Eaves		33-1262					
	Roofings		33-1263					
	Roof complementaries		33-1264					
	Miscellaneous roof elements		33-1267					
Plumbing	Water distribution system		41-2141					
Ventilation	Ventilation distribution system		42-2221					
Ventilation	Ventilation fixtures		42-2230					
Electricity system	Electricity distribution system in building		43-2331					
	Lighting systems		43-2350					

TEAM PROCESS



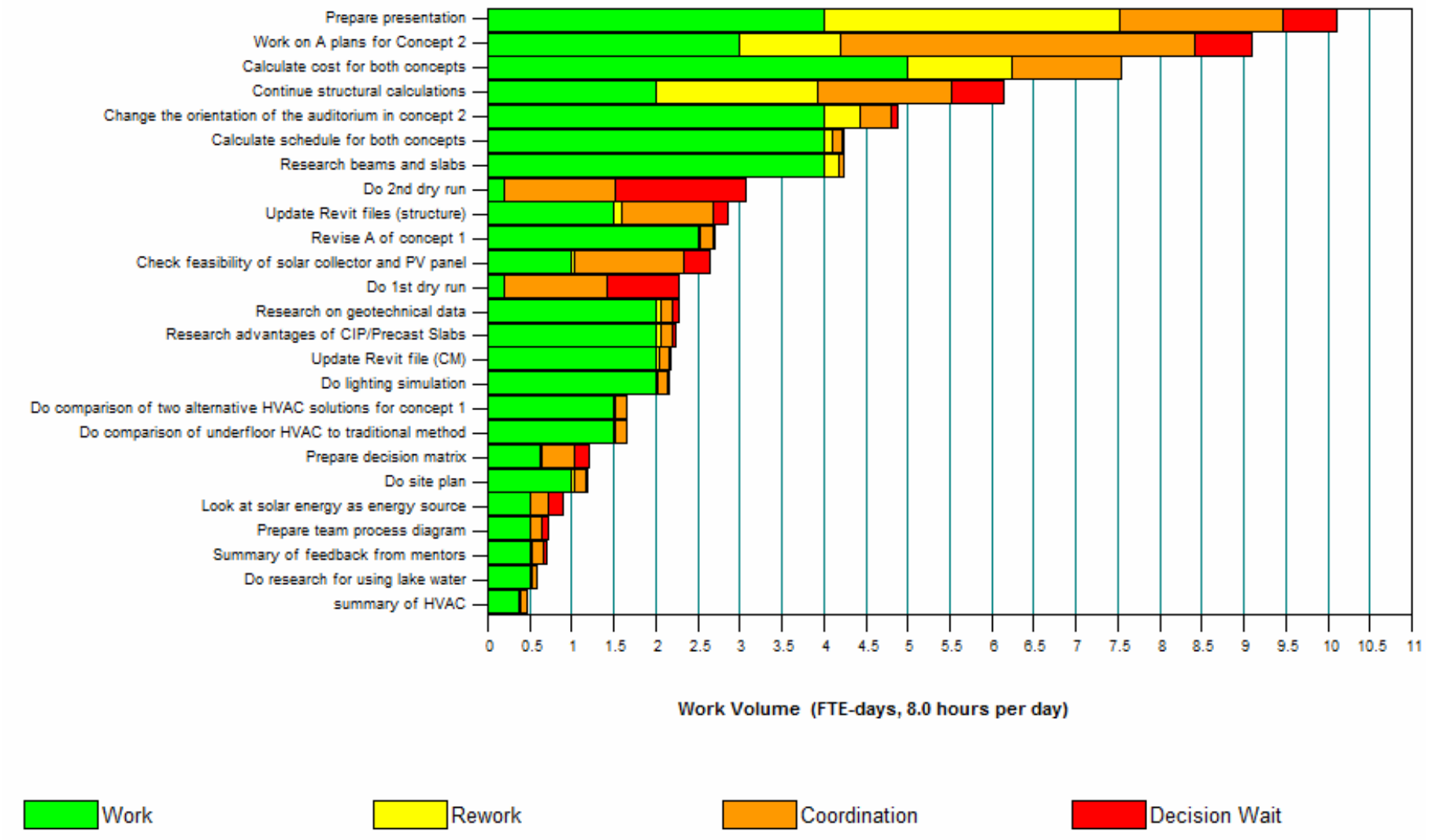
PROGRAM WORK BREAKDOWN

Till Mentor Crits

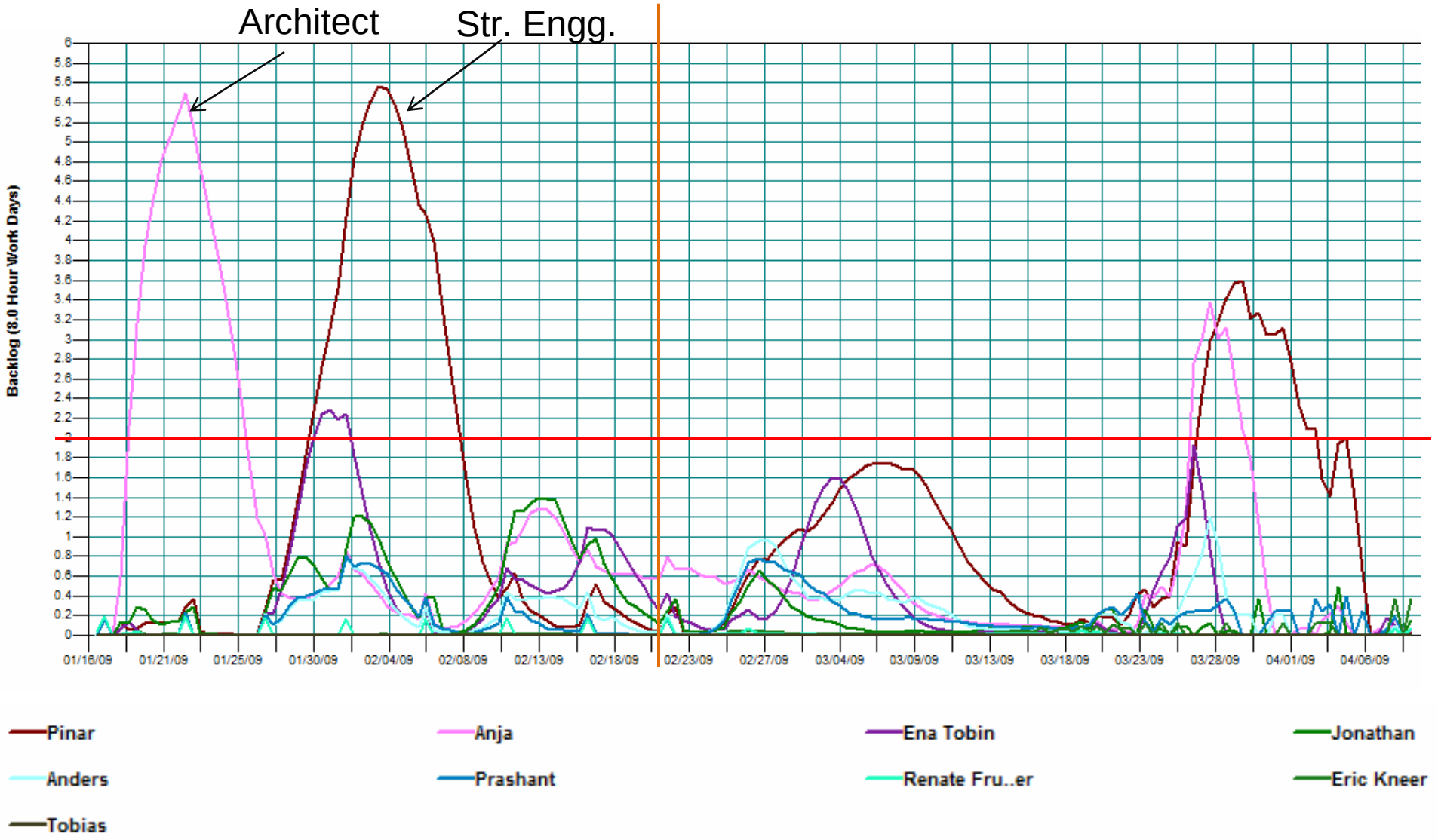


PROGRAM WORK BREAKDOWN

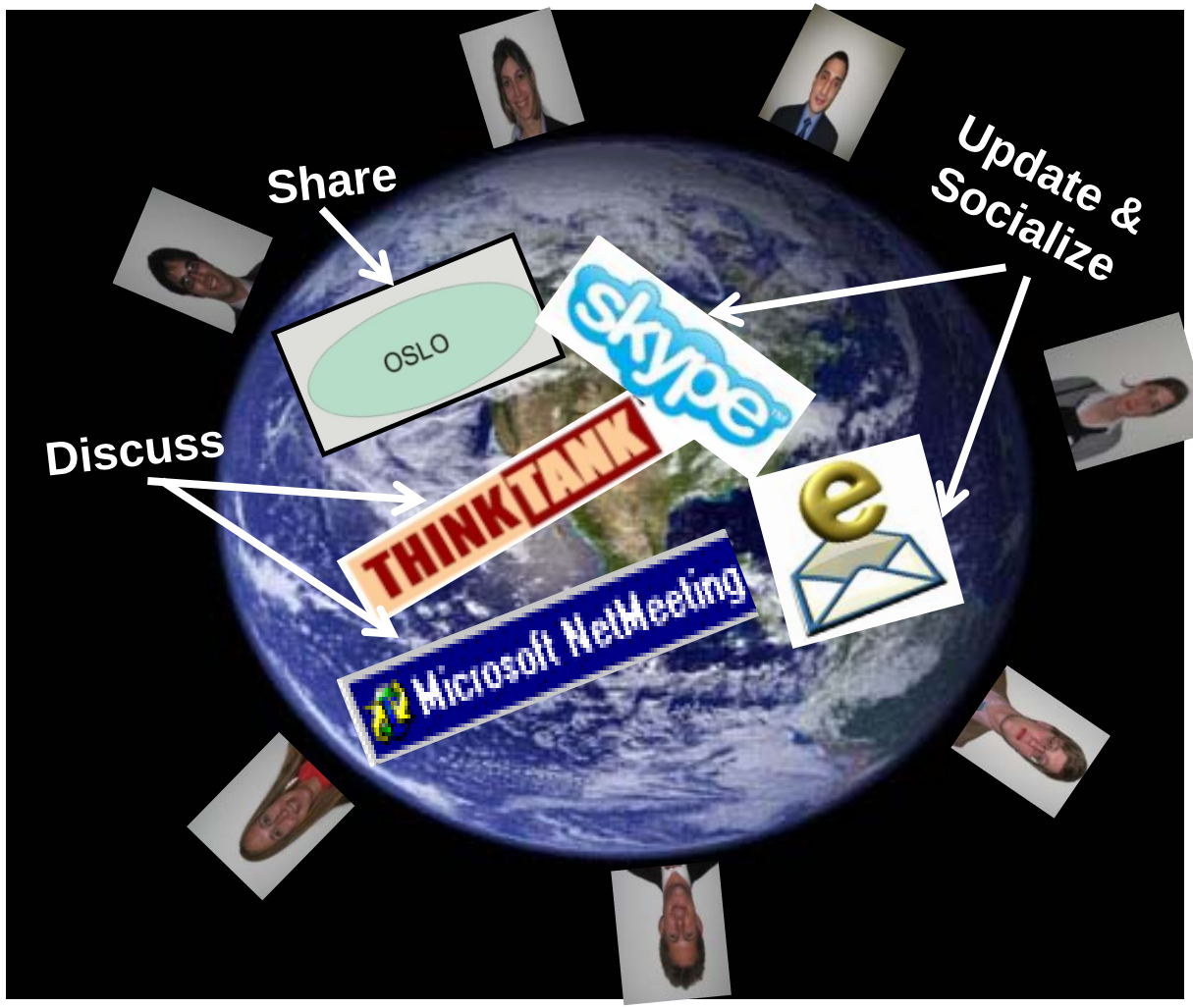
Mentor Crits – Winter Q



PERSON BACKLOG



TEAM PROCESS



Schedule → Designate → Work → Share/Discuss → Improve

DECISION MATRIX

	Concept 1		Concept 2	
	Steel	Concrete	Steel	Concrete
Architectural Vision overall	-		Y	
Surrounding Context (grid patterns, surounding buildings)	N		Y	
Surround Context (Views)	Y		-	
Internal Experience (Atriums, natural light,volume experience)	-		Y	
Mechanical room and service access	N		Y	
Programm diversity (movement of visitors, students, faculty - mixing)	N		Y	
Practical Design (facade, green roof)	-		Y	
Structural Integration overall	Y	-	Y	Y
Grid, spans, section sizes	Y	-	Y	-
Earthquake requirement	N	N	Y	Y
Problems with cantilever, auditorium, integration	Y	N	Y	Y

AEC Team

DECISION MATRIX

	Concept 1		Concept 2	
	Steel	Concrete	Steel	Concrete
MEP Overall	-	-	Y	Y
Space requirements	N	N	Y	Y
Energy Efficiency	N	N	Y	Y
Construction & Life Cycle overall	-	N	Y	-
Cost	Y	-	-	Y
Schedule	Y	N	Y	N
Constructability	Y	-	Y	-
Surface/Volume Ratio (Operation Cost)	Y		N	
Circulation area/usable floor area (economical efficiency)	N		Y	
usable floor area/gross floor area (cleaning cost)	N		Y	
Sustainability, Zero waste & LEED	Y	-	Y	-

AEC Team

DECISION MATRIX

	Concept 1		Concept 2	
	Steel	Concrete	Steel	Concrete
Architectural Vision overall	Y	-	-	-
Structural Integration overall	Y	N	-	-
MEP Overall	-	-	-	-
Construction overall	Y	Y	Y	Y
Life cycle cost overall	-	-	-	-
Sustainability, zero waste & LEED	-	-	Y	Y

Owner's Opinion

	Owner's Priority
Architectural Vision overall	
Surrounding Context (grid patterns, surounding buildings)	2
Surround Context (Views)	4
Internal Experience (Atriums, natural light,volume experience)	5
Mechanical room and service access	2
Programm diversity (movement of visitors, students, faculty - mixing)	4
Practical Design (facade, green roof)	4
Structural Integration overall	

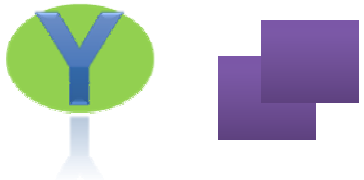
Owner's priority

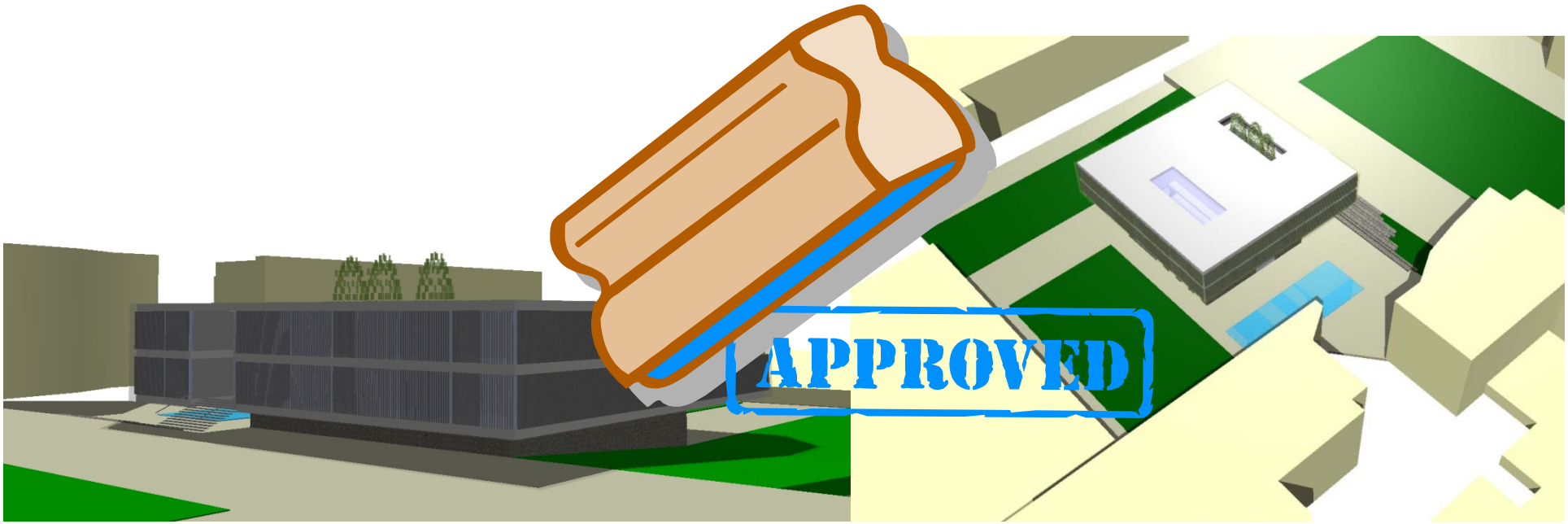
THE DECISION

- Owner's Input --- Concept 2 Steel

- AEC Team

Concept 1 Concrete	140
Concept 1 Steel	206
Concept 2 Concrete	268
Concept 2 Steel	284





“Nature” - Steel